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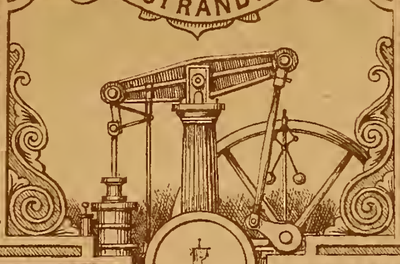

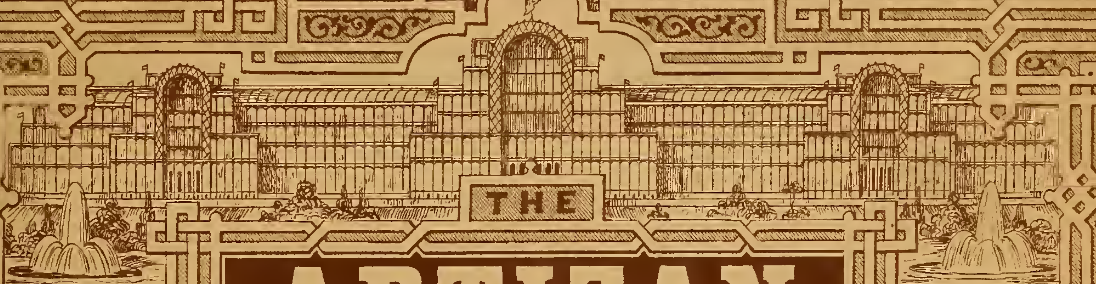

THE

ARTIZAN


A MONTHLY RECORD

OF THE PROGRESS OF

Civil & Mechanical Engineering.

SHIP BUILDING,

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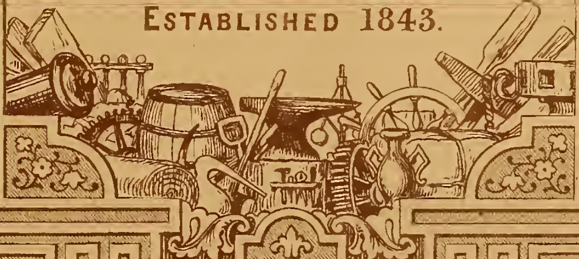

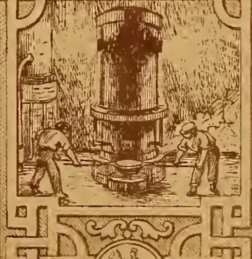


T. LANE DELT.

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TO THE BOOKBINDER.

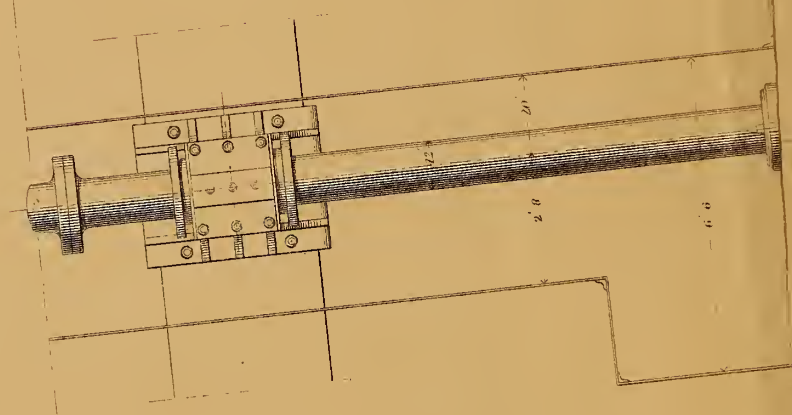
Sheet No. 18, in the June Number, is printed incorrectly; substitute for it sheet No. 18 in July Number.
Plate 85 to face title-page.

ENGINES OF THE SCREW STEAM SHIP "JASON"

BY

MESSRS JAMES WATT & Co

LONDON.



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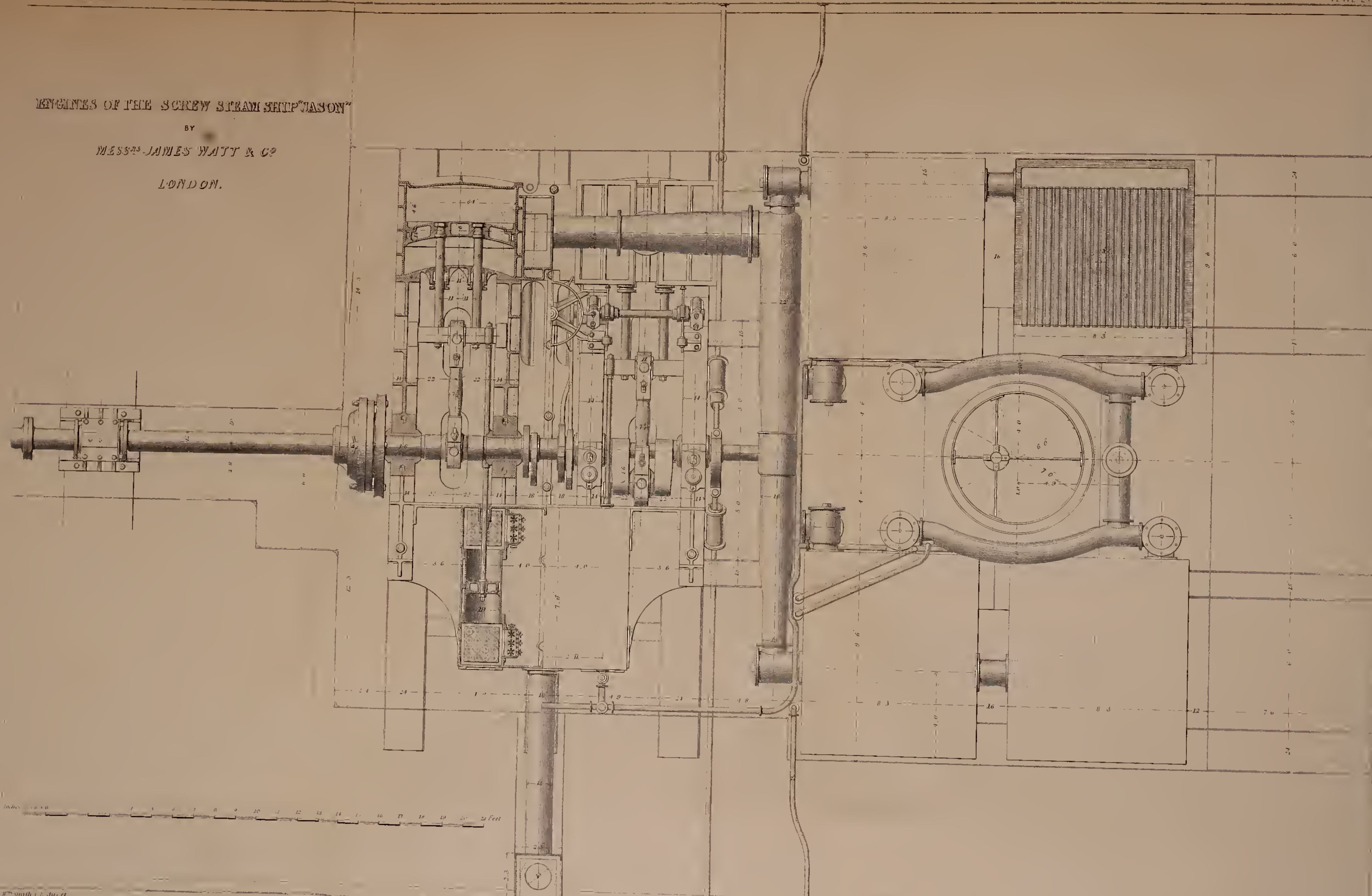
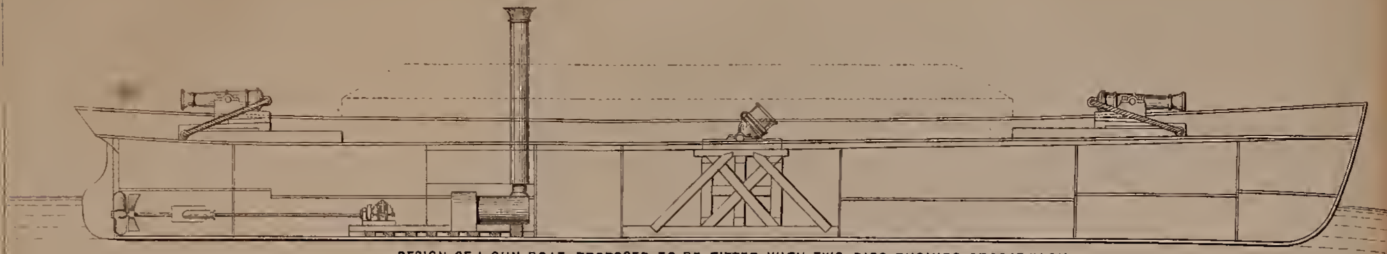


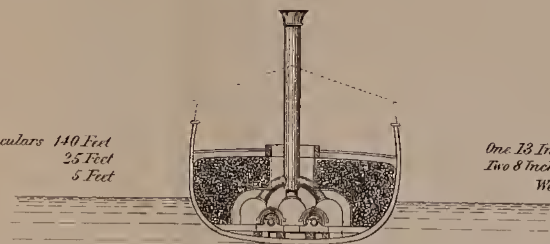
PLATE 63

W Smith C

C Chabot Zinco

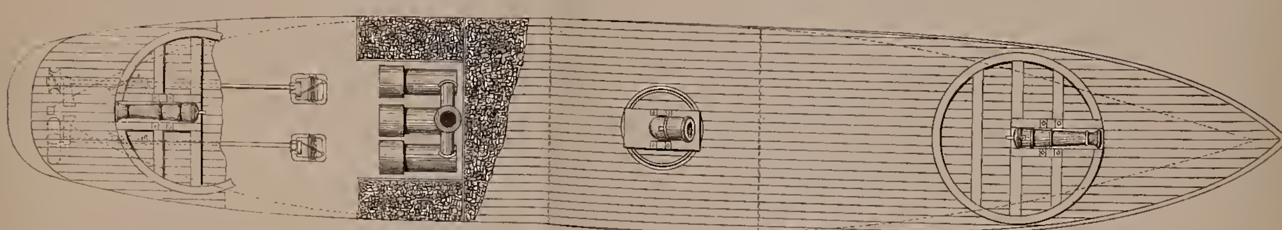


DESIGN OF A GUN BOAT, PROPOSED TO BE FITTED WITH TWO DISC ENGINES OF 30 HP EACH
FOR THE IMPERIAL RUSSIAN GOVERNMENT. IN THE YEAR 1853.
SCALE 1/8 INCH TO A FOOT
BY GEORGE RENNIE & SONS



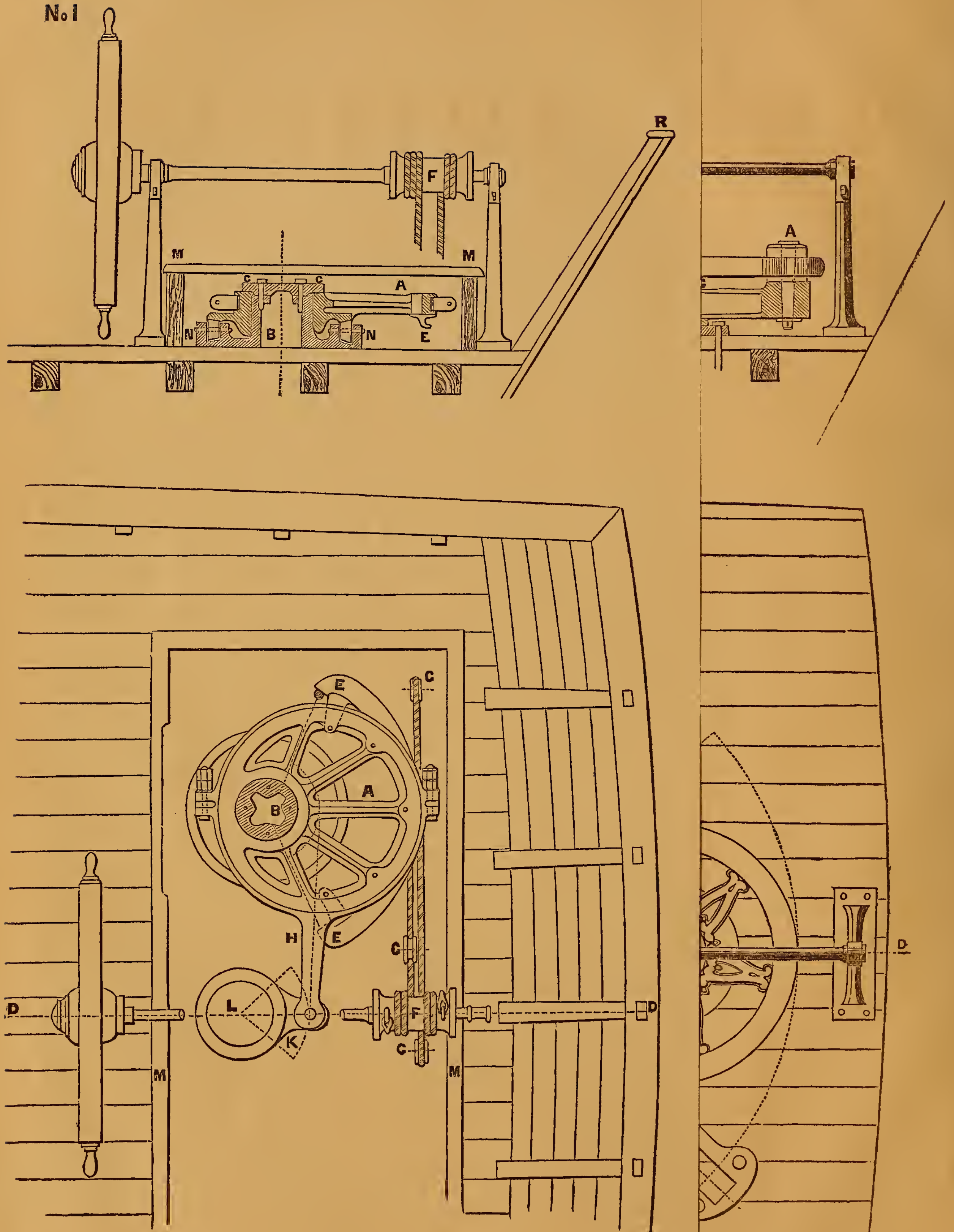
Length between Perpendiculars 140 *Feet*
Beam 25 *Feet*
Draught of Water 5 *Feet*

One 13 Inch Sea service Mortar
Two 8 Inch Guns 9 Feet long
Weight 95 Cwt.



W. Smith C.E. Del.

C. Chabot Lith.



W. SMITH, C E. DIREX.

THE ARTIZAN.

No. CLVI.—Vol. XIV.—JANUARY 1st, 1856.

"ARTIZAN" ADDRESS, 1856.

Another year has passed, an eventful one, truly, in the annals of this great commercial country, and in the history of the world. Our labours for the year 1855 have ceased, and we seize the occasion to address a few words to our readers with reference alike to our past efforts, and to our desire, intentions and exertions for the future. Many things occur to, nay, crowd upon our memory, which should be said upon such an occasion as the present; but we will first briefly advert to the past, and add a few words upon the future.

During the year which has just expired, we have, in our Thirteenth Volume, effected several improvements; and if we may judge by the opinions of those of our readers whom we number amongst our intimate friends, such improvements have been duly appreciated. We have treated of a vast number of subjects of great interest, and if we have not given them at great length, it must not be forgotten, that in the character of a magazine, with but limited space, and published at intervals of a month, we are compelled to give the greatest variety of subjects in each part, and to treat each subject as succinctly as possible. This we have done to the best of our ability, at all events, with sincerity and singleness of purpose, and we would feign hope to the satisfaction, indeed, benefit of our readers. Our articles upon the subject of marine-engine improvements, the advantages of the increase of steam-pressure used in our Royal Navy, the English floating-batteries, the new gun and mortar boats, the various novel mechanical inventions and contrivances for manufacturing purposes, or labour-saving machines, the new processes introduced into the arts and manufactures, and such novelties as we have thought interesting in connexion with commercial matters, and in relation to science, arts and manufactures, have been justly appreciated, and very extensively quoted by the scientific press of Europe and America.

For our treatment of the subject of the Paris Exposition we have been highly complimented, and feel thereby repaid for the cost and labour bestowed upon it. To have given a mere reprint of the catalogue would have been of little value, and quite unworthy of the high—and we hope we shall be pardoned for saying the justly high—reputation of our Journal. The marine, locomotive, agricultural, and machine-driving, engine builder, the gas, water supply, drainage, sanitary, electric, mining, and agricultural engineer, each finds in our review some information useful to him; and the chief points of novelty or merit exhibited in the great collection of industrial works, have been duly and carefully noted by us. But not alone will those we have enumerated be interested by our review of the works exhibited in the Paris Exposition;—the manufacturer and employer of instruments of precision, and of philosophical, astronomical, meteorological instruments and apparatus, will find recorded such names and instruments as specially deserve notice.

We have been informed that the description of the building—the general arrangement—the classification of manufactures and products of industry—and such-like information, given in the September and October Numbers, proved of great service to many who visited the Exposition, as well as to thousands of our readers who did not visit Paris, in rendering the whole plain and easily comprehensible.

The valuable paper by Lieut. Maury, U.S.N., on "Steam Lanes for crossing the Atlantic," was specially communicated to us in this country; for it we, at a considerable expense, engraved a plate specially prepared, and devoted to it several *extra* pages in our June Number; and in our July Number we gave a large and expensive chart of the fogs and gales along the Atlantic steam lanes, also by Lieut. Maury; and we have been gratified by finding that the rapid production of these important matters in our Journal was appreciated by those of our friends who are interested in securing greater safety and facilities for commerce and communications between this country and North America.

The subject of caissons has proved to be of greater interest than at first we were inclined to believe. Our remarks upon this subject, extending over several months, and the elaborate drawings and details illustrating the subject, have served to give our readers an historical account of the origin and progress of this important invention of Sir Samuel Bentham, and exhibit the best examples of such works as have been executed.

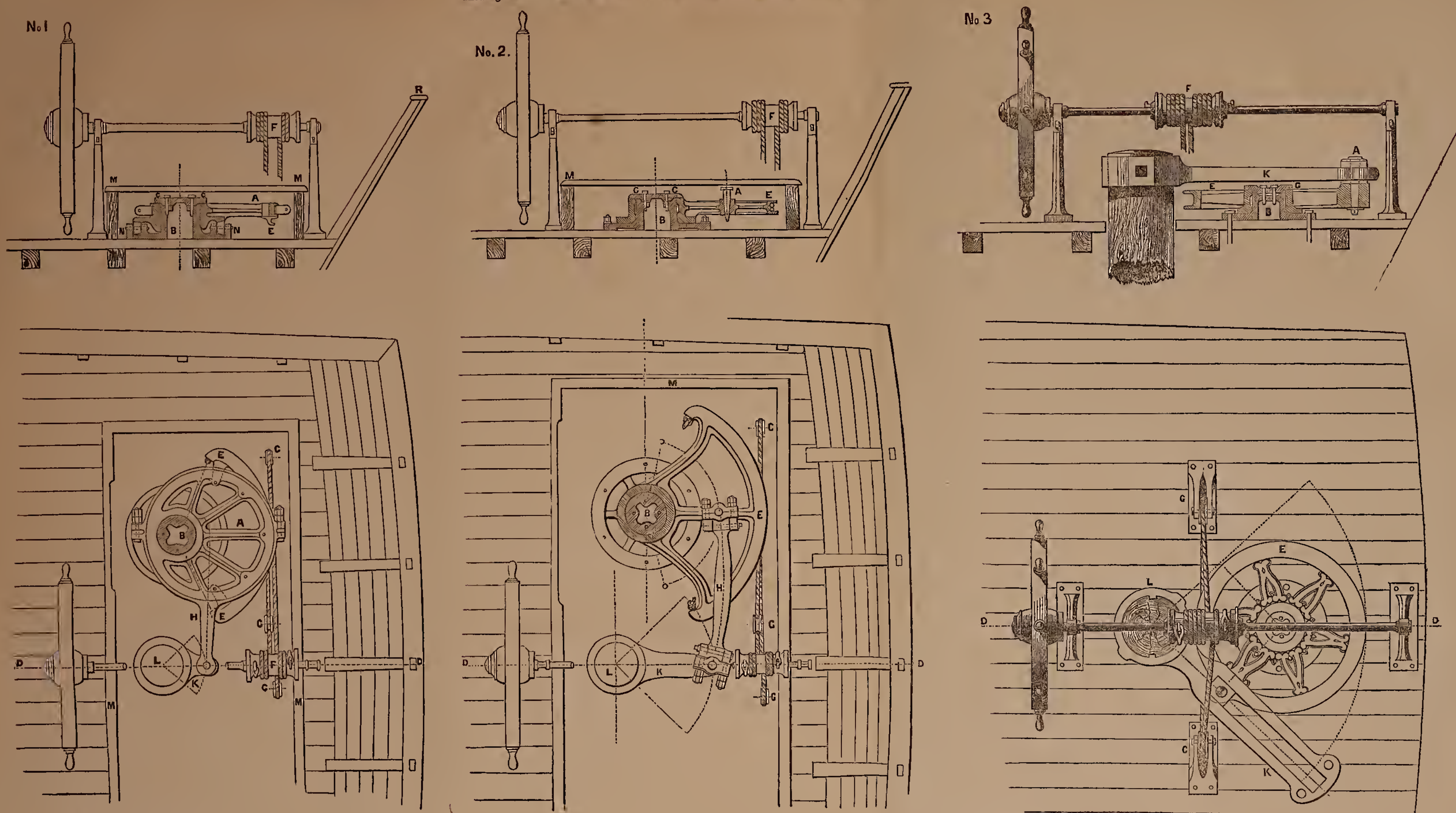
Our reports of the most interesting papers read at the Institutions of Civil and Mechanical Engineers, the Royal and Royal Scottish Society of Arts, and of the meetings of the British Association, and other Societies, have been given as early and as fully as possible.

The exposure of abuses and jobbing in such departments of the Government as are connected with the objects of our Journal have been promptly and fearlessly made. Errors of official judgment and official blunderings have been, we hope and believe, properly treated in our pages. The most recent case—that of the *Wye* steam-condensing ship—is a fair specimen of such matters, and a fair exponent of our mode of treatment of a gross case of mismanagement.

Our predictions have been fully realised with respect to our floating-batteries, and that, in spite of the alterations, *beyond account*, which were made therein, as if to prove us wrong, we refer with pleasure, and again point attention, to the letter of an esteemed correspondent, Mr. R. Armstrong, of Blackwall, published in our Number for August, 1854; and on comparing his propositions with the description recently given of French floating-batteries as *since* constructed, find them almost identical—their tortoise-like form and details of arrangement essentially differing from the floating-batteries constructed by the English Government. The inferiority of the latter for steaming, sailing, or steering, is a standing reproach to the practical department of the Government, and we gravely fear that the fighting qualities of those batteries will, on trial, be found equally defective. Here is afforded one more addition to the many records already in existence of the stolid power of resistance to enlightenment from without, which system and official routine have engrafted

GARR'S PATENT STEERING APPARATUS.

Shewing the three chief Modifications, of each of which a Sectional side Elevation and Plan View are given.



W. SMITH, C E. DIREX.

firmly in that department so vital to our maritime position in the world. The French batteries have been severely tested in actual warfare, and were found to withstand the heaviest projectiles fired against them at elevation, as well as point blank.

Fault-finding, without occasion, has not been our object; still less do we desire to court popularity by pandering to a vicious taste, rife at the present day, by which parties and policies are sometimes, for political motives, differed with, and dragged before the public from personal or party pique. We trust that, whilst we have felt it our duty to bring before the public blunders in practice in public works, and abuses in connexion with the administration of the public service, it will have been seen that we have never been betrayed into personal or offensive remarks.

Our series of "American Notes" have not proved uninteresting; but, on the contrary, very many items of information and notices of novelty, peculiarly American, have been not only worthy of our pages, but very useful to the English mechanic.

During the last twelve months our readers will find various additions have been made, and improvements introduced, for increasing the value and usefulness of The Artizan, and rendering it worthy of extended support by the scientific public, who have not hitherto had so high a standard work of reference, published monthly, relating to the branches of practical science and industry, to which The Artizan addresses itself. It has not been our object or aim to advertise inventions or patentees as a class, and to record monthly a mere list of the patents and specifications filed, irrespective of their object or merits; but such inventions as have been thought worthy of notice in our Journal, and considered of importance to engineers and those engaged in the practical science, have been given and illustrated when necessary.

Amongst the additions and improvements we have made we would call the attention of our subscribers to the fact that, during the present year, we have given them thirty-two plates, whilst, during the two preceding years, twenty-nine plates only were given. Many of those plates are elaborate, expensive, and most useful engravings of steam-engines and machinery, actually constructed, and in each presenting some features of a special or novel character. The plates have been engraved from the working drawings of the most eminent engineers and contractors—they have been produced in the style known and recognised in the scientific world as "The Artizan style;" and, in addition to the latter, we have given many plates which, whilst they are but little inferior, illustrate some practical and important work constructed, in progress, or projected. As during the last nine months more especially we have found such an accumulation of important matters crowding upon us as demanded the utmost space we could afford in our pages, we determined to relieve them of the larger wood engravings, which could only have been given to the sacrifice or exclusion of the letter-press; we, therefore, gave such engravings in an extra plate, and that occasionally double, and sometimes treble the ordinary size. In several instances we have, in addition, given a fourth plate. If these latter introductions did not appear engraved in the first style of art, they were produced in a manner sufficiently clear and accurate for all practical purposes, and were superior to, and more convenient than, the ordinary wood engravings, for which they have been substituted at considerable expense to ourselves; and we doubt not that our efforts in this direction have also been properly appreciated.

We would here remind our readers and the public that, whilst we strive with our best efforts of mind and money to cater successfully for the improving tastes of the scientific and practical portion of the world, it is on actual and material aid and support that we depend for commercial success, as well as for inducement to perseverance in extending the sphere of usefulness of The Artizan. Unlike the daily or weekly newspaper, containing information of immediate yet transient interest, The Artizan possesses the character of a magazine and review for recording the progress of the practical arts and sciences, so forming a library-book and standard work of reference, which should be possessed by every one connected with the matters on which it treats. It is published at a small price, which surely should ensure for it the largest possible share of public support; for it must be remembered that it is only by such means that an expensively-produced work can be made at all profitable to its proprietor in return for the very liberal and spirited manner in which, irrespective of pecuniary sacrifice, he has seconded our efforts in this direction.

In commencing a new year, we trust we may be excused hinting that a convenient opportunity is presented for those who have not hitherto enrolled themselves amongst our supporters, to do so at once. Whilst we venture this suggestion thus directly and candidly, we rely that the liberality evinced by the proprietor of this Journal in the past conduct of the work will protect us from any notion of such challenge appearing mercenary or otherwise than perfectly consonant with fair and manly independence. The high intelligence in all grades of the classes we are covetous of enlisting will, we feel assured, present to their views, and, no doubt, sensitively so, the idea that mutuality in interests is essential to securing continuity in even the best designs and most meritorious works.

These annual periods afford us the opportunity of testing one of the most important questions connected with scientific literature and class journals, viz., whether high-class matter of a scientific nature, with elaborate and numerous illustrations, can be produced successfully and profitably at the low price at which The Artizan is sold? We trust that *esprit du corps* amongst our brethren will enable us to give a response in the affirmative.

We have to thank our contributors for their valuable communications, and to acknowledge an obligation to several of them for their disinterested yet efficient services to the cause of science and the arts. Amongst the contributions here alluded to, have been many valuable practical suggestions, which have adorned our pages, and must have enlightened our readers; and, we have little doubt, have already been found of utility in practice to some of our and their enterprising professional brethren. It is always pleasant to us to circulate, as well as to encourage, meritorious suggestiveness, whether native or foreign.

In alluding to the future, we have but to assure our subscribers that our efforts shall not cease to be energetically and anxiously employed in that career of usefulness in which we have hitherto endeavoured to occupy ourselves; and we trust, that while we venture to congratulate ourselves on having been fairly successful in the past, yet that the sphere of our usefulness will become more enlarged, our energies be braced up and encouraged thereby, and, between us and our readers, increased and extended mutual satisfaction will arise, with attendant good results to the proprietor's interest. We have an immense fund of valuable materials still unexhausted, much interesting arrears to bring up, and every day produces new subjects for our treatment.

THE PARIS UNIVERSAL EXPOSITION, 1855.

STEAM NAVIGATION.

Although France is far behind this country in the development of steam navigation, yet her progress has been considerable, as the following figures will show:—In 1833-4 France had only 79 steam-vessels, having an aggregate power of 2,749 horses; in 1838 the number had increased to 160 vessels, with a power of 7,500 horses; and in 1842 there were 229 vessels, with an aggregate of 11,856 horse-power.

Since that time not only have the numbers greatly increased, but immense improvements have been made in the motive power, and by the substitution of the screw for the paddle-wheels. The French are universally agreed on the immense value of this substitution, especially for war-steamers, which can now carry the mechanism of the screw and the long shaft below the line of flotation, instead of carrying immense paddle-wheels exposed as a target to the artillery of an enemy.

As to the comparative increase of the old and new systems of navigation, it has been found that while the tonnage of sailing-vessels augmented in France to the extent of 14 per cent. from 1844 to 1849, that of steam-vessels increased during the same period to the extent of 60 per cent.

THE FOLLOWING NOTES REFER TO SOME MODELS OF FRENCH AND OTHER STEAMERS IN THE PRESENT EXPOSITION.

Screw steamer of 350 H.P., 2,500 tons burthen, to carry 1,200 tons of merchandise, and 600 tons of coal, by Nillus, of Havre.

Model engines of 900 H.P., constructed in the Port of Toulon in 1854-5, for the war-steamer *L'Algésiras*, of 92 guns, 1-10th of full size.

Internal diameter of steam cylinders	8 feet.
Stroke of piston	$4\frac{1}{4}$ „
Number of strokes per minute, for nominal power	45.

Pressure of steam in boiler 2·43 lbs. per square centimetre, equal to rather more than 16 lbs. per square inch.

The screw has six vanes, placed upon a globular swelling at the end of the shaft.

The shaft is about 40 feet in length, with a coupling apparatus in the centre.

The two cylinders are fixed at right angles to the shaft. Each piston is worked by four rods, which are attached to a cross head, communicating motion to the long shaft by means of a crank.

Engines for the steamer *Ebro*, of 80 H.P.—These have horizontal cylinders, placed longitudinally, with a piston-rod from each, connected with a cranked shaft. The centre of cylinders in same level plane as the centre of shaft. Paddle-wheel steamer.

Two models of engines, exhibited by M. Goêbe, the elder, of Nantes, are worthy of attention. In both of these the cylinders are inclined, converging towards an imaginary point below the bottom of the boat. One of these engines is of 55 H.P., and the other is 20; the smaller being intended for river and canal navigation. The boats to which they are applied are both screw-steamers, and there is something remarkably compact in the arrangement of the machinery. A good model of the screw-steamer *Danube* is also exhibited from the workshop of La Ciotât; and there are several interesting models of steam-vessels, exhibited by the French Minister of Marine.

The model of the *Danube* is perhaps worthy of a more particular notice. It is exhibited by the Company of the Messageries Impériales for Maritime Service, as the most perfect type of the vessels constructed by the Company for postal service in the Mediterranean and the Black Sea. The following are the dimensions of this vessel :—

Extreme length	253 feet.
Extreme breadth	35 „
Depth measured inside	22 „
Draught of water in middle	14 „

The nominal power of the engines is 370 horses; the velocity in calms is 13 knots an hour, or nearly 15 English miles, which the Company declare to be one of the highest speeds ever realised at sea, and one which can only be maintained by a large consumption of fuel.

The screw of this vessel has six blades.

From the United States of America there is a beautiful model of one of their magnificent river steamers, on a scale of 1 inch to 5 feet. The power of this vessel is 2,000 horses, the length 350 feet, and she only draws 6 feet of water. She has 94 cabins of the first-class, and 400 smaller cabins of the second-class. She can accommodate 600 first-class and 500 second-class passengers. Her capacity for burthen is 1,000 tons, and her rate of speed 25 English miles an hour.

From Great Britain we have models of marine steam-engines, with oscillating cylinders, by Penn, of Greenwich, as fitted in her Majesty's steam-ship *Sphinx*, of 500 H.P. Also the model of the steeple engines, with two vertical and two inclined cylinders, fitted on board the steam-ship *Simla*, by Tod and Macgregor, of Glasgow.

Amongst other beautiful models of steam-vessels, adapted for river navigation, some of which are fitted with a peculiar apparatus to give warning on approaching banks of sand and other shoals, Austria exhibits an exquisite model of the *Franz Joseph*, a paddle-wheel steamer employed on the Danube.

This vessel is about 220 feet in length, and 27 feet in breadth, with a capacity of 283 tons. Draught of water, when laden, 5 feet. The deck is entirely above the paddle-wheels, and projects as far as the outside of these, sweeping away from this breadth to each extremity of the vessel. The ordinary speed of the vessel is 15 English miles an hour. She goes regularly from Vienna to Galatz, 950 English miles, in four days.

Most of the French steam-boats used for river navigation have high-pressure engines, worked expansively, by having the steam cut off after a part of the stroke has been made. An article published in the "Siècle" of 21st August states that some boats with low-pressure engines were at first built by English makers for river navigation in France, but these were found wholly inapplicable to the purpose, owing to their great weight, their enormous draught of water, and the quantity of fuel which they consumed. In the words of the author these English boats produced *detestable results* on the Seine, the Loire, and the Garonne.

The French insist much on the necessity for lightness and swiftness in boats intended for river navigation, and assert that their boats have not only beaten the English on the small waters of France, but have shown a remarkable superiority in ascending the Rhine with considerable cargoes, and in preserving a monopoly of the navigation in the most difficult parts of the Upper Rhine.

MODELS OF SHIPS.

The French appear to have made small advances in iron ship-building. M. L. Aysnou and M. Gubbert, shipbuilders, at Bordeaux, exhibit models in which there is a mixture of iron and wood, but in those of the latter especially the wood predominates.

The shipbuilders of Dunkirk exhibit two models of clippers which, however, hardly come up to our notion of the clipper. They want the long and slender form, the extreme bending of the sails, and the fine bows which cleave the water without raising a wave, in order to realise the true idea of a French clipper.

Some of the best models of vessels in the Exposition are those sent by M. Carden, of Harfleur; but, unfortunately, these are only half models in relief, and do not afford to the unpractised eye so perfect an idea as the entire model. Those of which we speak are much admired by naval men. They are said to sail very close to the wind, and to behave exceedingly well in tacking.

One of the finest specimens of vessels in the French commercial marine is a model of the *Mathilde*, 640 tons burthen, sent by M. Levill, also a shipbuilder at Harfleur.

M. Petul, of St. Malo, sends a very pretty model of a schooner-yacht of fifty tons burthen. While the hulls of many modern ships are derived from and resemble the forms of the swiftest fishes, as the mackerel, the herring, and the dolphin; so the sails of some of the very fast specimens of the builder's skill remind us strikingly of the wings of birds. The beautiful yacht before us, with its raking masts, and white broad sails, which seem to court the wind, bring vividly before the eyes the slender rapid wings of the swallow and the lark.

The French have never yet been able to establish a line of transatlantic steam navigation, a deficiency which the commentators of their own press regret with no small mortification. They say that neither schemes nor offers have failed; that engineers, builders, capitalists, captains, crew,—all are ready. Exact estimates have been made of the returns from passengers and cargoes; yet, in spite of all these preparations, France has advanced no further than the production of a model, by M. Nillus, of Havre, for a magnificent vessel of 2,500 tons burthen, and 350 horse-power.

Messrs. Steele, of Greenock, and Napier, of Glasgow, representing here the shipbuilders of Great Britain, do not, indeed, exhibit models of transatlantic steamers, but have sent longitudinal and transverse sections of the packets *America*, *Canada*, and *Niagara*, as well as drawings of their engines. "One is struck with admiration," says a writer in the 'Siècle,' "before these incontestible proofs of the immense power of human genius."

Messrs. Mare, of Blackwall, have sent a great many specimens of their skill, both in the form of sailing-ships and steam-vessels. Amongst these is the model of the *Himalaya*, which, until lately, was the largest and finest ship in the world, but which must now yield the palm to the *Persia*, sent to sea on the 3rd of July last, by Napier, of Glasgow. The burthen of this vessel is 3,586 tons, or 36 tons more than the *Himalaya*. Her length is 590 English feet, or more than double that of the *Danube*, which has been already mentioned; while the ratio of breadths is only as 35 to 45.

The shipbuilders of Sunderland have sent a series of models for ships of various sizes, and amongst these are many which excel in the beauty and delicacy of their lines. We may mention, particularly, the *Lady Hodgkinson* and the *Emperor*, vessels in which the proportions are admirably contrived and well worked up.

The English have sent a great many models of yachts, which are much admired by the French. The *Novice*, the *Lotus*, and the *Circassian*, attract particular attention. The peculiar shape of these boats, so fine and slender beneath the line of flotation, and so rounded and swelling above, seem to fit them for sitting on the water like the swan, and floating at pleasure, like that most graceful of birds. The displacement of water made by these yachts is remarkably small; and though it has been observed that the accommodation on board these boats is excessively scanty, it must be conceded that a boat built purely for purposes of amusement, does not require, of necessity, those forms which are indispensable when its destination is different.

The French press complain that many of their first builders, as Messrs. Normand, of Havre; Malo, of Dunkirk; Chaigueau, of Bordeaux, and others, have not exhibited; but notwithstanding this they find abundant reason to congratulate themselves on the progress which is visible when this Exposition is compared with those of former years. It seems to be a general opinion with them, as with ourselves, that the long and slender build will supersede the rounder and shorter forms, both in sailing-vessels and steamers.

MANUFACTURE OF IRON AND STEEL.

England has long boasted a pre-eminence over all the world in the metallic arts, and especially in the manufacture of iron. Her rich coal and iron fields have concentrated in their immediate neighbourhood immense masses of population, who manufacture iron and steel into every shape, and supply nearly every market in the world with the produce of their industry. The abundance of canal and river navigation, and the comparative proximity to the sea coast, of all the English manufacturing towns, have combined to give England almost the monopoly of the world in the supply of manufactured iron. Since railways, however, have given so great an impulse to European industry, it has been found that many coal and iron districts, in France and other countries, are capable of profitable development, so that we must look forward to a time when the English manufacturer will find competitors springing up in remote districts, which have hitherto been scarcely known beyond their own immediate locality.

Never has this truth been brought forward in a more prominent manner than in the display of iron and steel in the present French Exposition, where the most distant departments of the east and south exhibit their rich metallic products in iron and steel. Foremost among these are the departments of the Isère and the Vosges, which, with other departments, flanked by the Swiss and Rhenish Alps, display a collection of steel and iron by no means contemptible. The departments of Tarn, Haute-Garonne, Arriège, and others in the southern district of the Pyrenees, are scarcely behind the eastern departments. There is also a large display of iron and steel from Westphalia, in Prussia, and from the famous iron and coal fields of Liege and Meuse, in Belgium. It is evident that all those continental nations which possess the means of bringing manufactured iron into the market are endeavouring to rival England, while the general establishment of railways throughout the Continent will undoubtedly aid these ambitious views to a very great extent. Under these circumstances it concerns the manufacturers of England to be stirring, and not to fail in that industry and spirit of progress which have always hitherto distinguished them.

The company for working the forges and foundries of Montataire, in the department of the Oise, exhibit iron plates of colossal dimensions, some of them not less than 60 ft. in length, and 4 ft. or 5 ft. wide.

Jackson, Petier, Gaudet, and Co., of Rive de Gier, in the department of the Loire, display a large collection of axles, specimens of turned wheel tires up to 12 ft. in diameter, boilers, and other heavy works, amongst which is the screw-shaft for the steamer *Eylau*, weighing 23,000 kilogrammes, or more than 20 tons. Other exhibitors have specimens of large castings for a variety of purposes. The French exhibitors also display powerful cranes, planing-machines, and other massive tools, for which the country has not hitherto enjoyed a very high reputation.

Belgium, Prussia, and Austria, but especially the two former, are also distinguished by their metallic manufactures. Among the principal of the Prussian exhibitors is Krupp, of Essen, in Rhenish-Prussia, who displays a large collection of steel adapted for various purposes, cranked axles of locomotive-engines, cranked axles for steam-vessels, steel tires cast in one piece for railway wheels, and a variety of heavy tools and machinery.

There are many other large exhibitors from Rhenish-Prussia and Westphalia,—as Puricelli Brothers, from the forges of Rheinbollen, Renard, of Gross-Streblitz, in Silesia, &c.

Amongst the larger class of tools employed for working in iron may be noticed especially the lathes and other machines exhibited by the Ecole Impériale des Arts et Métiers of Chalons. These tools appear strong, and well adapted to their purpose, although not so highly finished as those of Whitworth, and other English makers. Among the French tools, also, are punching, shearing, and slotting machines of the largest class, and powerful lathes for turning railway wheels. A planing-machine may be especially noticed, by Varrall, Middleton, and Elwall, of Paris, with a bed-plate 25 ft. long by 4 ft. wide; and a very large lathe, No. 1,196 in the Catalogue, by Calla, of Paris.

The space around the Panorama is rich in a display of all the smaller kind of tools of French manufacture. Among the most conspicuous of these is the cutlery of Raffin Fauron, from Thiers, in the Puy de Dôme; the saws, files, and scythes, exhibited by Coalaix and Co., from Klingenthal, in Bas Rhin; the large straight and circular saws, trowels, chisels, hammers, adzes, files, pincers, &c., from Zoraboll, in the same department; the large vices, pulley-blocks, saws, iron drilling machinery, spanners, and all kinds of small ironmongery, from Maubege, near Valenciennes.

In fact, the display of tools from all the iron-producing districts, both of the north-eastern and southern parts of France, show that our neighbours are treading very closely on the heels of our own manufacturers of Leeds, Sheffield, Birmingham, and Wolverhampton; and it is only by superior excellence of workmanship, and lowness of price, that the English manufacturer can hope to maintain his pre-eminence in the great markets of the world.

The Austrian tools are good and cheap, especially those for working in wood, which here command as much admiration as at the London Exhibition of 1851.

The Prussian display well deserves the same commendation, and it contains more of the larger class of tools than the Austrian. The lathes and shaping machinery from Mulhouse are thoroughly good and substantial, while the show of cutlery and small tools from Solinghen, as might be expected, is very superior. This collection comprises knives, razors, scissors, pincers, screw-cutting machinery, boring tools, files, saws, chisels, vices, &c., all well finished, and of first-rate workmanship.

The kingdom of Wurtemberg has a good show of carpenters' tools, comprising planes, saws, compasses, squares, grindstones, &c., &c.

The manufacturers of Great Britain have chiefly confined themselves to the larger class of tools. Among the principal exhibitors are Whitworth and Co., of Manchester, Smith, Beacock and Tannett, of Leeds, Buckton and Co., of Leeds, Harvey and Co., of Glasgow, &c. These celebrated makers display lathes of immense size for turning aud screw-cutting, planing-machines, slotting and shaping machinery, &c. The well-known names we have mentioned are a sufficient guarantee for the excellence of the tools which they exhibit. At the present moment the implements of these makers have a truly world-wide reputation. May it long continue to be so!

The pipes cast for the waterworks of Madrid are exhibited here. They appear to be cast from English patterns, with the ordinary spigot and socket joints.

Some cast-iron pipes, of small size, however, from Chatillon-sur-Seine, appear to have joints of a different kind, and are intended to be put together in a different method. The pipes are formed in the spigot-and-socket manner at alternate ends, but are not intended to be put together with lead. Each end of the pipe is provided with two ears projecting about an inch, and three-quarters of an inch apart. The ears are perforated in a direction transverse to the axis of the pipe. When two pipes are put together a short bar connects the ears of the two pipes, and is secured to them by a pin passing through the perforation of the ears. Pipes from 1 in. up to 9 in. diameter were provided with this contrivance. We scarcely know whether this mode of fastening the pipes be a substitute for lead joints, if so, it must be a very imperfect one.

MANUFACTURE OF COPPER.

This metal uudoubtedly ranks next to iron wheu we consider the numerous uses to which it is applied in the arts. Less hard thau iron, but more malleable, its value for domestic utensils is equally great. It is also much used for making bronzes, brasses, and alloys of all kinds.

If France and other countries pretend to some rivalry with England in the manufacture of iron, there can be no doubt whatever that the copper-works of England rauk far before those of all the rest of the world. In England alone are the ores of copper scientifically treated, and here alone are the smelters able to treat every separate ore of eopper, while in all other countries the treatment is only suitable to their own peculiar indigenous ore.

The quantity of copper annually produced from all the countries in the world may be taken at about 52,000 tons, of which, about 28,000 tons are made in South Wales alone, chiefly in the neighbourhood of Swansea. Russia, Austria, and Sweden come next in order as copper-producing countries, while France only contributes to the extent of about 700 tons a year. Of the 28,000 tons manufactured at Swansea, at least two-thirds are derived from foreign countries. In Great Britain itself, Cornwall and Ireland contain the principal copper mines; but the enterprising copper merchants of Swansea receive large contributions from Cuba, the shores of South America, and Australia, while, nearer home, an incousiderable quantity is sent from Italy and Algeria.

The principal advantages which Swansea possesses as a seat for the manufacture of copper, are its position as a seaport and its proximity to a great coal field yielding inexhaustible quantities of anthracite and other valuable coals at a cheap rate. Probably in no other district in the world are these advantages so intimately combined. In every other case, land carriage interferes more or less to raise the price of conveying the coal or the copper ore, raising, of course, in a corresponding ratio, the cost of producing the copper. Add to these peculiar advantages the great skill and able processes which have long distinguished the copper smelters of Swansea, and it will be seen that we possess a great superiority over all other countries at the present time.

The French are already looking forward to their colony of Algeria as a productive source of copper, and are meditating the formation of smelting works ou the shores of the Mediterranean, near Marseilles. M. Le Play, a celebrated mining engiueer, and one of the Imperial Commissioners for the Great Exposition, has also pointed out the basin of Caronte, on the Mediterranean, as a place offering great advantages for the establishment of copper-works. He refers to the metalliferous chains of the Aude, the Var, the Hérault, the Lozere, of Forez, of Lyons, of Beaujolais, which would each contribute a certain proportion, to be brought down by the Rhone and its numerous tributary streams. He proposes that coal could be brought cheaply from the coal basin of Alais, and observes as to the great advantages which the neighbourhood of Marseilles would possess for the importation of copper ores from Italy and Algeria.

The Exposition contains some very interesting specimens of copper ore. One of the most remarkable is that exhibited by a French Company, from Lake Superior, in North America, and which is said to require only a single smelting to produce pure copper.

The collection from the Argentine Republic, amongst other very fine specimens of minerals, contains some beautiful examples of sulphurets of copper. England is represented by Messrs. Blankart and Son, of Neath, who exhibit specimens of carburets and sulphurets of copper; and by Mr. Morris, for mining companies in Devonshire.

Austria has probably sent a more varied collection of minerals than any other country, and among these are many beautiful specimens of copper ore in various stations of transition towards the pure metal. The Austrian collection is also rich in manufactured copper. The company for working the mines of Upper Hungary exhibits many specimens of copper regulus, and copper in the form of sheets, bars, and plates, from the works of Phenixgulte.

Although the copper works of France are insignificant, there is a considerable display of ores from several of the French departments, as well as from her colony of Algeria. The mines of Chessy aud St. Bel (departments of the Rhone), send some fine specimens of copper pyrites, and of the azurite or blue carbonate of copper. Pégu and Brassac, both in the Puy de Dôme, are also represented by specimens. There is also an establishment in the Pas de Calais, established for the smelting of foreign copper, which has sent specimens. Among these is one from Corocoro, containing 75 per cent. of copper, although the usual yield from this locality does not exceed 25 or 30 per cent.

The "Presse" and other French papers speak in confideut terms of the rank which France is destined hereafter to assume amongst the copper-producing countries.

TIN, ZINC, LEAD, MERCURY, AND THE PRECIOUS METALS.

Although the part played by the French themselves is very meagre, it is said that the display of these metals, ou the whole, is more complete than in the London Exhibition of 1851.

The finest general collection of minerals is probably that from the mountains of the Hartz, exhibited by the administrative authorities appointed by the King of Hanover and the Duke of Brunswick for managing those valuable miues.

The district of the Hartz forms a mountainous group, of which the Brocken occupies the grand central and culminating points. From the earliest period has this famous mountain been celebrated alike for its marvellous ballads and its mineral wealth. The giant spectres of the Brocken are familiar to the readers of German romance, and even our own nursery tales have derived some of their choicest marvels from the fables of this haunted region. Who has not heard of the annual visit of the witches, mounted on their brooms, and sailing through the air, to find their patron, the devil, among the wild solitudes of the Brocken? Here, also, has Goëthe planted one of his principal scenes in his play of Faust. For those who would trace the industry of mines to its earliest source, the mountains of the Hartz must ever rank with Saxony as the classic land of mining enterprise, which here dates as far back as the tenth century. Here, in reality, commenced the science of mining; geological phenomena were here first observed with a practical tendency; the superposition of strata was first studied; and all the various arts of the miner first practised on a large scale.

The geological maps and plans of the mining district, exhibited by the royal and ducal administrations we have named, the specimens of rocks and minerals, and the models of apparatus, give some idea of the gigantic operations which have beeu going on for ages in the bosom of these mountains. There are adits here, for the purpose of draining the mines, upwards of fourteen miles in length. The mode in which water traversing the mines is utilised and made valuable is worthy of notice. Conveyed from various surrounding points around the shafts and mines, the water often precipitates itself over falls of several hundred feet in height. The water is received by hydraulic wheels, or works as a column, to put in motion machinery for pumping, ventilation, and extraction.

The collection of minerals from the Hartz comprises copper, lead, silver, arsenic, zinc, and sulphur; and several interesting models exhibit the process of crushing and washing the ores, in order to separate the metallic particles from the earthy matter with which they are always largely combined.

An ingenious apparatus, termed a wind-sorter (*tireur à vent*), is exhibited by M. Victor Simon, engineering-director of the mines of Nouvelle Montagne, in Belgium. The most recent improvements made in the preparation of ores have had for their object the reduction of the crushed grains as nearly as may be to the same size. The washing process acts much more rapidly and with greater precision upon sand in which the grains are nearly of the same size, and separates the heavier grains, namely, those which are metallic, from the lighter and earthy grains with which they are mixed. M. Simon therefore submits the grains as they come from the crushing machines or stampers to a current of air. This current of air is transmitted through a tube, which increases in size, from the orifice which receives the crushed mineral, to the other extremity. The consequence is, that the current of air diminishes in velocity as it proceeds through the tube, and the effect is to cause grains of the same size to be deposited in different parts of the tube. The sands of various degrees of coarseness, thus simply assorted, are then submitted to the process of washing, and a great economy, both of time and metal, is said to result from the previous arrangement thus effected by the blowing apparatus.

Zinc is almost entirely produced by two countries—Belgium and Silesia. The Belgian works are largely represented by the Company of the Vieille Montagne, which also extensively contributed to the London Exhibition of 1851.

This Company exhibits in the transept of the Palace some very creditable works of art in zinc, having all the finish and delicacy of bronze. We find the Vieille Montagne Company again in the Belgian department, where it is represented by magnificent blocks of calamine, and by manufactured products of zinc; and again in the department of the Zollverein, where it has placed the ores of zinc procured from Rhenish-Prussia.

Besides the Company of the Vieille Montagne, there are others from Belgium, namely, the Company of the Corphalie, and that of the Nouvelle Montagne. Both of these exhibit largely, and present an interesting series of calamines, blende, galena, and iron pyrites, from the thick beds on the banks of the Meuse.

Mines of lead and silver, metals which are sometimes found isolated, but more commonly mixed, have probably given rise to the largest mining operations in the world. There are argentiferous mines of lead in the Hartz, in Saxony, in Cumberland, Derbyshire, Sweden, and Mexico, which furnish the principal proportions of lead and silver.

The whole quantity of silver produced throughout the world in 1851 was about 1,000 tons, of which Mexico alone yielded more than half. Chili, Peru, and other states of South America, yield together about one third as much as Mexico. The following is the rank of the silver-producing countries of Europe: Spain, about 40 tons annually; the Zollverein, about 37; Austria, about 28; Russia, about 17; England, about 16; France, under 2 tons.

Although Sweden only produces annually about 2,700 lbs. of silver, she has sent over some beautiful specimens of native silver to the Exposition, from the mines of Königsberg.

The process of procuring silver from its ores cannot be effected without the use of mercury. In the Mexican works every pound of silver requires $1\frac{1}{3}$ lbs. of mercury to be used in amalgamation; hence the great importance of cinnabar, or the ore of mercury.

It is said that some large discoveries of cinnabar have lately been made in South America; and that mercury can now be obtained at San Francisco for half the price which it commands in Europe.

The mines of gold are represented by a fine collection of nuggets from Australia; also by gold dust, obtained by washing, and specimens of auriferous quartz from Australia and California.

The annual production of gold, at the present moment, for the whole world, is nearly 286 tons, of which California and Australia alone contribute 240 tons. Russia produces nearly $24\frac{1}{2}$ tons, and Mexico nearly $6\frac{1}{2}$, while few other countries contribute any large proportion.

A great change has taken place within the last few years in the relative production of gold and silver. At the commencement of the century, the weight of silver was forty-three times that of the gold produced all over the world. In 1846, the weight of silver was only eighteen times that of the gold; and since the gold discoveries of California and Australia, it is only triple.

The disproportion in the monetary value of the two metals is even greater than that of the absolute weights. Some curious speculations have been made as to the consequences of this revolution in the relative values of the precious metals, and many different opinions are entertained as to the probability of the yield of gold being permanent. Sir Roderick Murchison, whose eminent geological attainments and extensive acquaintance with auriferous deposits in all parts of the world entitle his opinions to the utmost respect, is of opinion, not only that the alluvial deposits of gold in Australia and California are of limited extent, but that the veins of auriferous quartz will diminish in richness the further they are explored, so that there is little probability of the present large production being continued for any great length of time. At all events, the production of gold from quartz veins is much more costly than from the washings of alluvial deposits, while processes are in agitation considerably to increase the production of silver, and render it less costly. It follows, from all this, that the equilibrium between the two metals may be restored in the course of a few years, although, it must be confessed, the whole subject is one of considerable uncertainty.

WORKS OF HYDRAULIC ENGINEERING.

There are several models exhibiting a system of moveable dams, fixed across rivers in order to stop the whole flow or any part of it at pleasure, and direct a current upon any particular part of the channel.

This system of moveable dams is the invention of M. Poirée, Inspector General of Public Works, and has been applied upon the Seine and the Yonne.

The moveable sluices used by M. Poirée consist of ten small piles, each 3 in. square, and about 6 ft. long. These ten piles are united so as to form one sluice, about 6 ft. long and 30 in. wide. The sluices rest against an iron frame-work fixed across the river.

I believe there are no examples of these self-acting dams on English rivers. Their principle of construction is such, that where the water of the river is low, the dam or *barrage* as the French call it, completely stops the flow and prevents the channel from becoming dried up. When more water comes down, or when it accumulates to a certain height, the *barrage* yields in a corresponding manner, and allows part of the volume to pass. The opening, in fact, of the *barrage*, adjusts itself to the variable volume of water in the river, and either contracts to suit the very smallest flow, or expands to admit the whole volume of the river where the water requires a free course over the whole breadth of the channel.

The first self-acting *barrage* appears to have been constructed by M. Poirée, in 1834, across the Yonne, near Clamecy; another was constructed, in 1836, across the Loire, at Decize; and, in 1838, across the Yonne, at Epineau.

In 1839 the Jury of the French Exposition for that year awarded a gold medal to M. Poirée for his invention; and, in 1844, a gold medal and the decoration of the Legion of Honour were conferred on M. Thuard, engineer in chief of roads and bridges, for a cheap form of *barrage*, erected by him across the river L'Isle, at Absac.

There are also interesting models of the locks at the Port of Dunkirk, where there are five lock chambers, with an extreme depth of about 24 ft.—each lock about 22 ft. long and 16 ft. wide.

Several of the models exhibit a practice adopted by the French engineers, of forming square blocks of artificial stone by means of hydraulic mortar (concrete) pressed into square sacks, and fitted together in the same manner as blocks of stone as soon as the contents of the sacks have become thoroughly set and solid. These artificial blocks average about 2 ft. 6 in. long by a foot deep and 18 in. wide.

Model of a single wrought-iron sluice, for closing an opening of about 27 ft. wide, as applied upon the Seine at the tollhouse of La Monnaie. The gate here is in a curved form, and is suspended by radial bars from the centre of the curve, which has about 20 ft. radius. The plan of the gate, or a transverse section, taken in the line of one of the radii, is bounded by two lines—one a straight line, and the other an arc of a circle, so that the thickness of the gate at the sides is only a few inches, but in the centre is more than 2 ft. The gate is well and strongly built of wrought-iron plates, rivetted in the best manner, and represents a further modification of that honeycombed structure which has been so extensively adopted of late years in wrought-iron tubular bridges. The gate is raised by winding up a chain which passes up vertically to a pulley, and then goes horizontally to the crab or windlass.

The gate, in rising, swings on its centre, and describes a curve; and being connected with the centre by six strong radial bars, the gate is kept firmly in position during the whole process of raising and lowering without the large amount of friction which attends a common vertical sluice.

Model of lock-gates of the ordinary form, entirely constructed of wrought-iron plate. These gates are each about 20 ft. wide and 25 ft. high. They were constructed by MM. Michal and De Lagallisserie, engineers in chief, and M. Poirée, sub-engineer. The iron plates of which the gates are formed are bent or corrugated almost into a semicircular form, which gives the structure a great addition of strength. Each gate is provided with three paddles, each of which closes two openings or sluices.

(*To be continued in our next.*)

THE "WYE" STEAM-CONDENSING SHIP.

The readers of The Artizan will find, on referring to their October Number, that we gave a plate of this ship, with a very full description of the novel apparatus on board. We felt bound to comment in very strong language on the conduct of the parties who had superintended the fitting out of the vessel, and to remonstrate with the heads of the mechanical department of the Admiralty, at having allowed an engineering undertaking, novel in its main features and very important in its results, to be put into the hands of a *clerical* officer, whose time must be fully occupied with his own duties, if these duties are well and faithfully performed.

When these remarks were penned the ship was at Spithead: subsequently she was taken off to Osborne, to be exhibited to the Queen and Prince Albert; they, however, did not honour the ship with a visit. From Osborne the vessel was again ordered back into Portsmouth Harbour, to receive certain last fittings which were discovered to be required at the last moment, just as the ship was under sailing orders. After these were all complete day succeeded day, and week succeeded week, till it was supposed by the officers and crew on board that they had been really forgotten by the authorities at Whitehall; and here we may remark that it is very much to be regretted that the additional boiler, which on trial was proved to be needed, and was promised to be sent out to be fitted at the seat of war, was not added at that period, since any ordinary engineer would have seized that occasion to make his vessel fully efficient; the opportunity was lost, however, and the ship is, to use a military phrase, "*as she was!*"

We know not whether to take credit to ourselves for having roused the slumbering energies of the authorities, but we were told by one of the late officers of the ship, that within a week after the appearance of our article no small stir was created on board the *Wye*.

The captain, officers, and crew had all been kept on full pay during the many months the ship was in progress, and their pay alone must have cost the public many thousand pounds,—this was done that the ship's company might be thoroughly up to their work; but no sooner did our article appear than they were all, every-man-Jack, from the captain downwards, turned out of the ship. The whole of the ship's company complained that they had not been treated fairly, more especially the captain, who had resigned a superior appointment at the special request, it is said, of the Comptroller of the Victualling Department.

We would here take the opportunity of assuring those who felt the truth and justice of our remarks, that the ship's company had neither part nor lot in the matter, and if their discharge was intended for a piece of retributive justice the authorities have sadly missed the mark.

Subsequently, a naval officer (a master) was appointed, with a new set of officers and crew; this change occupied only about six weeks. The *Wye* sailed for the Crimea, laden with stores, on the 11th November, exactly five months from the time she first made her appearance in Portsmouth Harbour.

It is reported that she is to be a store-ship, and not to be used as a steam-condensing vessel; this we cannot believe, for she has cost the country many thousands of pounds, and is reported to have distilled at the rate of 35,000 gallons a day; but taking this statement at a somewhat lower amount, and the ship for what she is worth, pray let us see her applied to her original destination, for she must be a valuable attendant on an army on an enemy's coast.

We have noticed briefly in our pages the departure of the *Chasseur* floating factory, the floating flour-mill and bakery, and we now notice the departure of the *Wye*. We have numerous correspondents at the seat of war, and we have requested some of these engineering friends to report on these various novel additions to a fleet and army. When such reports reach us we will not fail in giving them publicity.

THE "REPULSE" (91 GUNS) NOW THE "VICTOR EMANUEL."

The engineers are rapidly progressing with this ship. An incident connected with the change of the name of this ship is worthy of record. When our very popular ally, the King of Sardinia, was on his visit to Portsmouth-yard, and going over the side of the ship, it was announced to him that it was the wish of the Queen that from henceforth the *Repulse* should, as a *souvenir* of the King's visit, bear the name of *Victor Emanuel.*

The *Victor Emanuel* is a sister ship to the now famous and crack ships the *Agamemnon* and *James Watt*, and we doubt not but she will prove, when ready for sea, quite a match for either of these splendid ships. The machinery is by Maudslay, Sons and Field. The following are a few of the principal dimensions:—

	ft.	in.
Length between perpendiculars	230	0
" of keel for tonnage	195	$2\frac{1}{8}$
Breadth, extreme	55	6
" for tonnage	54	8
" moulded.	53	10
Depth in engine-room	24	6
Burthen	3,102 tons.	
Height from deck to deck.	7	5
" " " beam	6	3
Armament	91 guns.	
Nominal H.P.	600	
Diameter of cylinders		76 ins.
Length of stroke.	3	6
Diameter of screw.	18	0
Pitch of do.	25	6
Length of do.	3	0
Diameter of screw-shaft	0	14
No. of boilers	4 pieces.	
No. of furnaces	20	
Diameter of tubes.		$2\frac{1}{2}$ ins.
Length of do.	6	7
Diameter of funnel	7	7

THE NEW STEAM FRIGATE "SHANNON."

In our last Number (Vol. xiii., p. 294), we noticed with pleasure that the greatest activity prevailed throughout the various shipbuilding yards, both public and private, in preparation for the next year's campaign in the Baltic, and that upwards of 100 new vessels of light draught of water would be completed by the early spring. We now note with pleasure the completion and launching of the *Shannon*, the finest frigate in the Royal Navy, launched at Portsmouth, 24th November, 1855.

We have never been advocates for pinching and starving the wooden walls of old England. We know that connected with their honour and remembrances are entwined some of the most glorious and brightest jewels in our national history. And we never could chime in with men calling themselves merchant princes, who, knowing the value of progress, find it profitable and necessary to keep pace with the improvements of the age, by changing their old machinery in their own factories in many instances oftener than every ten years, while yet, as economists, they grudge the same privileges to that which is of national importance, and on which the honour and safety of the nation, and the very possession of their own wealth, depends. It is still insisted by many who should and who do know better, that the *old* ships could still be retained, altered and fitted with steam power. But we can assure those who are but superficially acquainted with shipbuilding and the principles of naval architecture, that no private shipbuilder or proprietor would be a *solvent* man for a dozen years who would attempt such a thing. The laws which govern floating bodies, and the forms best adapted for their propulsion, are now so much better understood, that putting first cost out of the question, the economy in *working* the new ships is a fact which cannot be doubted, and that they are the cheapest to the nation must be admitted by all.

Let any one look at the style of the new ships, especially in the passenger traffic—at the great length, which gives speed with the same immersed midship section; the height 'tween decks, which gives comfort and health to the crew; and, we must add, the space from port to port. This space in the *Shannon* is over two feet greater than in the old class of ships, and is invaluable to the ship's company, especially in working the heavy ordnance, now so common in our men-of-war. We give the dimensions of the old *Shannon*, so well known in naval history, alongside her successor, and we may express a wish that the new vessel may be as equally distinguished in our naval history.

	New Shannon. Steam Frigate.	*Old Shannon.* Sailing Frigate.
Length between perpendiculars	235 ft. 0 in.	150 ft. 2 in.
Length of keel for tonnage	203 ft. 5 in.	125 ft. 6 in.
Breadth, extreme	50 ft. 0 in.	40 ft. 0 in
Breadth for tonnage	49 ft. 6 in.	39 ft. 6 in.
Breadth moulded	48 ft. 6 in.	38 ft. 6 in.
Depth in hold	18 ft. 4 in.	13 ft. 0 in.
Burthen	2,261 tons.	1,066 tons.
Armament :—		Upper deck, 28
Main deck, 30 guns	8-in. 65 cwt.	18-pounders.
Upper deck, 20 "	32-pndrs. 58 cwt	Quarter deck &
" " 1 "	68 " 95 "	forecastle, 18
Total ...... 51 guns		32-pounders.
		Total, 46 guns
Height from deck to deck		7 ft. 1 in.
Height from deck to beam		6 ft. 3 in.

Machinery and boilers by John Penn and Sons,	of Greenwich.
Nominal H.P.	600
Diameter of cylinders	70 inches.
Length of stroke	3 ft. 6 in.
Diameter of screw	18 ft. 0 in.
Pitch of screw	25 ft. 0 in.
Length of screw	3 ft. 6 in.
Diameter of screw-shaft	13 in.
Number of boilers	4 pieces.
Number of furnaces	20
Diameter of tubes	$2\frac{1}{2}$ in.
Length of tubes	6 ft. 4 in.
Diameter of funnel	7 ft. 6 in.

THE "TIMES" *v.* THE ROYAL DOCKYARDS.

There are but few amongst us who fail to recognise in the "Times" one of the great facts of the day. Whilst we enjoy its broad sheet, its latest news, and deeply appreciate the good effected by its masterly exposure of the state of our army during the trying period of last winter, we sometimes regret in its leaders the flippant air and straining after stage effect that detracts from their excellence.

We have been led into these remarks by an article which appeared in its columns on the 4th of December last, relative to the visit of the King of Sardinia to Portsmouth Dockyard.

The writer, in chronicling the royal progress through this far-famed national arsenal, takes occasion to enter into the question of the state of the dockyard, viewed as a great national manufactory. He expresses himself in strong and disparaging language of its present *status*, and asserts "that it is not *up to the times*—its tools *antiquated*—its system *obsolete*—and its works abortions—since the engines made at that establishment have proved worthless, and are always breaking down."

Grave charges, when preferred by a journal whose broad sheet circulates throughout the civilised world, reaching both friend and foe. Desirous, however, of seeing and judging for ourselves, we made a pilgrimage to Portsmouth and inspected the dockyard, in order to give our readers an account of its present aspect and condition, knowing, as we do, how many of them are interested in mechanical and engineering operations, and being sensible that the etiquette of the public service precludes the subordinate official, however competent, from noticing or replying to any statement, however rash, whilst its exigencies entirely occupy the chief authorities of the Admiralty, and preclude their defending themselves and their departments.

Fault-finding is fashionable, especially when the mark is high. We know that writing after that fashion is very palatable with the unthinking many, who will swallow it greedily. We feel, however, that amongst our readers a desire may justly exist to know how far the executive government fulfil their responsibility by availing themselves (in this great struggle in which the honour of the country is at stake) of those mechanical and engineering resources for which we are famous.

In describing our visit we will follow the route taken by the royal party, as described by the "Times," and, first, take the block-machinery.

We had visited, and carefully inspected, this far-famed machinery about twelve years ago; with great pleasure, since that time, we have often heard it commended by those whose approbation carried weight and authority on questions in mechanics. At that time we found a degree of slovenliness in the general appearance of the works. The mill-gearing consisted of square cast-iron shafts, heavy wooden pulleys, and the old-fashioned methods of driving by rope-bands and tightening-pulleys. However, to our great surprise, we found, on our last visit, that these relics of the past had disappeared, and that the most modern style of mill-gearing, consisting of bright wrought-iron shafting, turned iron-band wheels and riggers, had been adopted, and the machines driven by leather bands and fast and loose pulleys.

With respect to the machinery (*properly*), it consists of three separate sets of machines, all precisely identical in kind, but different in size: first, a set of boring, morticing, turning, shaping and scoring machines, for *small* blocks, a similar but larger set of machines for middle sized, and another set still larger and heavier for the very largest sized blocks. All these machines are on the ground floor, together with sundry circular and horizontal saws for cutting up the trees, and performing sundry other operations required in the earliest stages of the process.

In the upper floor of the works we found various machines for the lighter processes of preparing the lignum vitæ sheaves, lathes for turning the block-pins, as also machines for polishing and testing these pins; but we saw no hand labour going on, and the workmen about the machines appeared to be all alive and active.

We were informed that the small set of machines could turn out, with ease, in the day of ten hours, about 300 pieces, the middle-sized set about 140 pieces, and the largest set in proportion.

To practical men, who know what has been done in block-making, we venture to say that we know of no private establishment, the productive powers of which are at all equal to this; neither do we know any machines the mechanical movements of which are superior or better adapted to their work than the block-machinery of Portsmouth Yard: it has been at work upwards of fifty years, and from it has sprung the slotting, drilling and shaping machines, and the slide-rest of the present day is a matter reflecting immortal honour on the names of Sir S. Bentham, Brunel, and Maudslay; and we still say, notwithstanding the sneer of the "Times," that we feel proud that such machinery is the property of the nation, and that it was worthy of being shown to our royal visitor and ally.

If we might venture on one suggestion to the authorities of the yard, it would be that the pulling or dragging into the mill, and under a cross-cut saw, a log of timber, by a few men struggling with a rude kind of winch, did appear out of keeping with the whole, especially where so much power for hoisting and hauling is at hand; surely, this could be very easily remedied.

From the block machinery His Majesty Victor Emanuel was taken to the great smithery, and here the writer in the "Times" has a good growl, principally because the work in hand was not heavy, or something of the monster kind—the work in hand shown to the King being only a capstan-spindle, weighing in the rough about a ton or 30 cwt. Our worthy blacksmiths are taken roundly to task because they showed, with some pride, the wonderful power which man had over matter in the steam-hammer. The same machine which can give an herculean blow equal to 50 cwt. can also be made to give one so gentle as to crack a nut and not injure the kernel. For the information of the "Times," and others, we would say that the smith's work required in shipbuilding is comparatively light work, and for the Admiralty to erect ponderous and expensive hammers, and other such works for making ship's knees, riders, and capstan-spindles, would certainly not be putting the right machines in the right place.

The building is got up for show, and we are rather surprised that this did not please the superficial eye. The building is somewhat after the style of the Crystal Palace, and, on looking over it attentively, with all its interior slight pillars carefully guarded and protected, we come to the conclusion that the work carried on inside is made to suit a building designed for architectural effect.

It covers a square whose sides are each about 200 feet; at each corner of the building is a large square brick chimney, about 120 ft. high. Between eighty and ninety forges of all sizes are placed within this smithery; the small forges ranged alongside the walls, the larger forges running parallel to the small, with a space of about 35 ft. roadway between.

The smoke from the forges is carried off very well indeed, by horizontal flues running immediately over them. The chimneys of the forges are connected with the horizontal flue, having a slight bend as they enter it on the under side. Each large brick chimney takes the whole of the smoke from the forges on each side of the square. At the angles of the shop are small steam-hammers for the convenience of the lighter kinds of work in progress. The forges are of very good and workmanlike construction. The cranes are numerous, but they are necessarily self-contained and expensive, on account of the fragile nature and construction of the building.

There are also two Nasmyth hammers—one of 50 cwt. with four furnaces, and one of 30 cwt. with two furnaces, and we are told that it is proposed to put up a 5 ton hammer with its furnaces. And here we think the authorities are wrong. In our opinion it is impossible to combine heavy forging with ordinary smith's work, especially under one roof; it is not done in private trade, and if it is done in the dockyard, it must be yielding to clamour, such as we find vented in the "Times," and it must be more for show than profit. A massive chimney stands in the centre of this great building, round which these heavy hammers with their furnaces are ranged, and into which all the furnace-flues are carried; and as these flues must necessarily be carried underground from the furnace to the chimney, they will never be found to act well, and will be the source of continued trouble.

We found a very beautiful and useful application of steam-power in the shape of one of Nasmyth's punching-presses, driven by a small high-pressure cylinder, thus obviating the necessity of shafting.

There is also a capital bar-cutting machine by Sharp Brothers, of Manchester; drilling and screwing machines by other Manchester makers; and the whole internal economy of the department reflects great credit on the chiefs who conduct it. To ourselves it appeared a subject of regret that the building was not of brick. Iron and glass we think out of place for a permanent building intended for such a purpose to last for many years, and we can fancy the trouble, annoyance and expense consequent on the wear and tear of twenty years.

Still following the royal visitors, we went to the steam factory, and we would remark, that it would be well for the "Times," should a similar incident occur again, to send a correspondent who can get up his case with some show of intelligence. We have often read in Blue Books, and seen by the discussions in the House of Commons, that the Admiralty never intended that these establishments should be more than workshops where boilers could be made and repaired, and where the engines and other machinery of steam-vessels could also be repaired; hence, we were not a little surprised when we read in the "Times" that the engines *made* at these factories had been unsuccessful, and that they were always breaking down. But we were not surprised when the "Times" found out that a very large proportion of these works were appropriated to boiler-making and repairing.

It was very easy for the writer in the "Times" to dash off his disparaging judgment on the engines made at the steam factories, *damning*, as he did, the professional characters of the engineer officers, both at the Admiralty and also at the factories; and we doubt not that these gentlemen felt it so: but our readers will not be a little surprised when we tell them that this statement in the "Times" is simply *untrue*,—there have never been, as yet, a pair of marine-engines made at either of the steam factories of Woolwich or Portsmouth. The only approach to this has been at Portsmouth, where a pair of geared four-cylinder engines have been reconstructed and converted into two distinct pairs of direct-acting engines. The one pair is now on board the *Termagant* frigate, the other pair is on board the troop-ship *Simoom*, and both pairs of engines will, we are informed, bear a comparison with the most modern screw-engines in Her Majesty's service.

We will now attempt to describe the workshops and plant of the steam factory. The steam-basin appeared to us to have wharfage enough for about seven line-of-battle ships. With one pair of masting-shears, and another pair adapted for putting boilers and engine gear on board; also, five cranes, to carry 20 tons each. The principal workshop is a noble building, separated from the basin we have just described, by the width of a roadway. This building is about 700 ft. long, divided internally by four party walls, forming five compartments; a floor is carried through the whole length of the building at such a height as to leave about 36 ft. or 40 ft. for the height of the under workshop, from floor to floor. Three of the five compartments are used for boiler-making. In each of the boiler shops are two 20-ton travellers—one steam, and two of Fairbairn's lever-riveting machines. The punching shop (as the compartment is called where all the tools are placed together) is filled with some of the best tools we have ever seen, and they appeared admirably arranged for carrying on the work.

With the style of the boiler work we were particularly struck; it appeared even superior to the very best we had ever seen in private factories; it looked clean, regular, simple, and substantial. We were told that several sets of boilers had been made by some of the London makers, with the view of testing the question of economy, namely, whether boilers could be made cheaper in the factory than they could be purchased from private firms. We wish some Member of Parliament would elicit this information, as, from what we saw, we doubt not but that such information would tell very much to the credit of the boiler-makers of the Portsmouth steam factory.

We found in this part of the works a valuable practice, which is worth copying. The boilers are placed, or erected in position, as they would be on board ship; and all the valves, cocks, pipes, and other mountings are fitted; this must facilitate the work on board ship very much indeed.

In the other parts of the factory, appropriated to fitting, erecting, turning, &c., &c., are found an ample supply of the very best and most modern tools, with every convenience which has hitherto been introduced for the economy of labour.

One fact we were told, and we here place it on record, as it is a feat we have never heard excelled, namely, that a pair of 400 H.P. screw-engines, with boilers and shafting, weighing about—say 200 tons—were put on board, fixed, fitted, and started within fourteen days!

The iron foundry we found small for the amount of work in hand, but we were told that a larger foundry is already designed. The brass foundry we found on a very large scale, turning out principally small castings, to the amount of about ten tons weekly: the system of stereotype moulding is carried out with great advantage in casting nails for decks, &c., and such articles as are required in large quantities.

We had never before so fully seen the steam factory works, and accustomed, as we have been, to the works of our very best and most celebrated engineers, both in London and elsewhere, as also to the make-shift style of many of such establishments, we were more than ever struck with the really admirable arrangements of Portsmouth steam factory and its thorough adaptation as a repairing establishment; and we must add, that to those who designed these works, as also to those who now practically superintend them, great praise is due, and we would, moreover, recommend our young engineering friends who have not seen, to go and visit them, for we feel assured they will thereby be both pleased and profited; and to our mechanical readers we would say, that should the war still continue, and should the steam navy still increase, as it must, these works are the nucleus of a noble and yet more extensive repairing factory.

Having followed the royal visitors thus far, we ventured into a part of the yard to which they were not taken, and we were not surprised at it, for reasons about to be mentioned, and in which we think our readers will concur:—this was the ropery. The visit to us was of much interest, as we had, in our early days, taken great interest in rope machinery, and indeed pride ourselves on our knowledge of it; but were we to indulge in the spirit of the "Times," we could say a great many very strong things about this machinery, or rather want of machinery, in this department. We have found that no progress has been made during the past fifty years; the gear which we saw at work was so rude and rickety, that we were really surprised at the superior quality of the cordage turned out of hand, it being, to a great extent, made by the "rule of thumb."

It seems strange to us, and we could not discover any reason for it, that the machines now used in private trade should be totally ignored in this department of the dockyard. We beg to assure the authorities that machinery is now used with profit and great gain in point of the strength of the rope; and that such system of machinery, by a continuous series of operations will hackle the hemp, spin the yarn, form the strand, and lay up the rope. And we would suggest that until such shall be adopted in this department, it would be well to forbid strangers inspecting this part of the works, and so seeing the "nakedness of the land" in a royal dockyard.

One last word with reference to the bilious remarks of the "Times." Our impressions, excepting only in relation to the ropery, were of a character opposite to those so fully comprised in that journal; and we can assure our readers that the workshops and machinery shown to His Majesty Victor Emanuel are worthy of the country, and they are fair, nay, good specimens of the mechanical skill of the first mechanical nation in the world, let who will say to the contrary.

IMPORTANT EXPERIMENTS TO ASCERTAIN THE EFFECTS OF GRADES AND CURVATURE ON RAILWAY OPERATIONS.*

Data Collected and Examined by Alfred Sears, Civil Engineer.

So long as the clay in which we are moulded is of grosser fabric than the mind, so long as the hand is harder than the brain, just so long will machinery of all sorts fall in its practical application below the standard of duty marked out for it by the formulæ of the philosopher. When we have ceased our labours to elevate man, we may withhold our efforts to perfect his work.

Hence, then, till a result is accomplished that shall render experience unnecessary, experience will be interesting and valuable. If the result obtained from data furnished by properly-conducted experiments be found to modify accepted doctrines, they aid in bringing formulæ into practical shape, and thus, too, they produce a still nearer approach to *perfectness of adaptation* in the machine to which they apply.

Of especial importance are the recent experiments on the New York and Erie Railroad. In the subjects they reach they are more extensive, in the influence they must exert more considerable, and in the effects, measured by a financial scale, as valuable as any other class of data that can be gathered from railroad practice. They yield truths to be regarded by the constructing engineer, and convey important suggestions to those having charge of the working of railroads, while they are also of interest to the locomotive machinist.

The object in view, at present, is to introduce the result obtained, more especially to the notice of the civil engineer and railroad superintendent. They will give additional data for the calculation of the much-vexed question "of the equation of distances," an important problem in engineering, and one that has been subject to much confusion. As to gradients, the cause of the difficulty is, that many eminent men, who should have known better, have confounded the *angle of repose* with the *angle of double resistance.*

The latter cannot be a constant quantity, but is governed by the circumstances of the load and its portage. The *angle of repose*, on the contrary, may, for practical purposes, be assumed as constant, 0° 09′ according with the latest experiments. This angle produces an inclination of which the rise is ·258 of the length of the plane, equivalent to a grade of 13·7 feet in a mile—or referred to resistance to motion, is equal to a friction of 5·8 lbs. per ton.

This supposes the plainest case, being that of a car on a track without joints, and moving with a velocity indefinitely slow,—a case in which atmospheric resistance amounts to practically nothing, the motion indicating only that friction is balanced. The amount of power used to produce this result is called the friction of the train. It expresses, however, but the friction of the cars of the train.

A comprehensive thought will at once convince the engineer of the fallacy in that equation by which this simple element is made the only resistance encountered or worth estimating.

The *angle of double resistance* varies with the load—the style of the engine—the velocity. Other causes affect it, but these are the principal, and are always present. Hence, in estimating the value of different lines, it is important to consider the kind of business to be accommodated; whether chiefly a passenger or freight traffic; light trains at high rates of speed, or heavy trains at less velocities.

To ascertain the actual resistance offered by grades and curves, and thereby their relation to a level tangent, was the object of these experiments. While this knowledge is of value to the company on whose road the trials were made, as aiding in a more intelligent, and, therefore, more economical distribution of power, it was by no means monopolised by them. In order that the information there obtained might be generally diffused, Mr. McCallum invited the representatives of several journals to be present—designing to solve an important problem as an engineer, while he served the interests of the company as superintendent. The profession will thank him for his liberality and thoughtfulness on such an occasion. Owing to a severe and sudden attack of illness, the general superintendent was prevented from conducting in person these experiments, a fact that must account for want of comprehensiveness in some of the notes—rendering them useless for all purposes of accurate investigation. Sufficient, however, has been gathered to serve important practical purposes.

This paper will present those results only that are founded on reliable data. It will, therefore, be necessary to avoid all consideration of works accomplished by extraordinary methods, and expedient to omit notice of those miles that are of such mixed construction in grade and alignment as to compel calculations on short sections with the use of *averages*—a dangerous element in such problems.

Those situations of the trains on descending grades, in which the brakes were locked, are of course incidental to all railway locomotion, but form no part of the phenomena to be considered.

The organisation of the trial train was completed on Monday, the 27th August. Operations began on Tuesday. The train left Dunkirk, the western terminus of the New York and Erie Railroad, at as early an hour as the state of the track would permit; a dry rail being necessary to a fair exhibit of the adhesive power of the engine. The parties officiating were—

Zerah Colburn, who, on account of the illness of the general superintendent, directed the movements of the train, and superintended the collection of data.

Stephen B. Bowles, time-keeper, &c.

Charles D. Cooper, and William Thomas, mechanical engineers, were appointed a committee of inspection to secure the experiments from the

* Extracted from the "American Railroad Journal."

effect of sectional prejudices, if any such bias should be discovered on the road.

Israel G. Yorke, engineman, in charge of engine "No. 210," which was appointed to the performance of these duties.

Weight of engine	66,000 lbs.
„ on drivers	40,000 lbs.
Diameter of blast orifice	$2\frac{1}{2}$ in.
Diameter of cylinder	1,417 ft.
„ driving-wheels (coupled)............	5 ft.
Length of stroke of piston...........................	2 ft.

These figures are necessary elements in the calculations incidental to the experiment.

[The foregoing is from the "American Railroad Journal" of September 22nd; while the remainder of the paper is from the number bearing date November 24th. This explanation will render the following paragraph intelligible.—Ed.]

When, several weeks since, this paper was prepared for publication, I did not think it would be necessary to make in its matter any material changes, and therefore allowed the first part to appear in the "Journal."

In the meantime, I had reason to suppose that a new series of experiments were under consideration, to be more carefully arranged than any others, and the results, therefore, of more considerable advantage.

Supposing it would be of greater value to the profession than what was already prepared, the subject was not immediately continued. No new trials have taken place, but the means of correcting a few items of the old data have been presented, and there can be no doubt that a part of the delay is well made up in the greater accuracy of these returns.

For the rest, I can only plead the inexorable demands of business which have prevented earlier attention to the subject.

The formulæ made use of are those of De Pambour, and I have adopted the practical co-efficients determined by his experiments, when they have not been expressly ascertained for this purpose.

The experiments were made with heavy trains, the composition of which was regulated by the "ruling grade" of the various divisions of the road.

These trains weighed, on different occasions of the trip, including engine, tender, and caboose, as follows, viz.—train, designated for convenience,—

No. 1, composed of 25 cars	....	982,140	pounds.
No. 2, „ 30 „	....	1,145,790	„
No. 3, „ 100 „	....	3,545,390	„
Weight of tender, roadworthy	....	42,240	„

The width of the Erie railroad gauge is 6 feet.

To illustrate what has been said concerning "Equating for Grades," it will be interesting to estimate the amount of resistances to be overcome with some of these different loads before they can be moved on the track.

1. The atmospheric pressure of 14·7 lbs. an inch on each piston, of which the area is 227 inches, may be reckoned as $2 \times 227 \times 14{\cdot}7 = 6{,}674$ lbs.

But as the power of the engine is directed to the circumference of the drivers, it will be necessary to find the value of this element of resistance at the same point, to establish a relation between them as well as between this and the other resistances.

The pistons travel two strokes, measuring 4 ft., while the wheels make one revolution, during which they have passed through 15·71 ft. Hence the proportion—

$$15{\cdot}71 : 4 = 6{,}674 : x = 1{,}699 \text{ lbs.}$$

2. The back-pressure resulting from the construction of the blast orifice, and which depends on the velocity of the engine, may be represented, when referred to the periphery of the driver, by

$$\frac{4 \times 454\,p}{15{\cdot}71} = 116\,p,$$

in which p = back-pressure in pounds per square inch.

Hence, then, $1{,}699 + 116\,p$ = the resistance in pounds arising from atmospheric pressure on the pistons and the action of the blast-pipe.

3. Let T = number of tons (gross) composing the load, including tender, and f = friction of load, being the number of pounds required to move one ton upon the track; in this case, 5·7 lbs.

Then $f.\,T$ = resistance opposed by the friction of the load.

4. Let g = effect of gravity in pounds per ton, and W = weight of engines in tons gross, then $g\,(T + W)$ = the effect in pounds produced by the gravity of the train, to be added to or deducted from the other resistances, as the grade is ascending or descending. Then,

$$f.T \pm g\,(T + W) \text{ or } T\,(f \pm g) \pm gW =$$

the resistances opposed by the friction of the load and the gravity of the train.

5. We come now to estimate the resistance occasioned by the air through which the train is moving, and which must be considered as at rest, since no observations were taken to measure the amount of its effect. The amount of frontage may be called equal to the greatest cross-section of the train, increased by 10 square feet for each car, including engine and tender.

Let bv^2 = this resistance in pounds at the velocity v of the train: then, $f.\,T \pm g\,(T + W) + bv^2$ = resistance from friction of load, gravity of the train, and the air.

6. One other obstacle to the progress of the train remains to be considered,—the friction of the engine.

Let F = the friction of unloaded engine, being in this case 348 lbs., or 12 lbs. per ton:

Let r = additional friction due the load, to be measured as a fraction of the resistances summed up in (5), being for coupled engines about ·22:

Then $F + r\,[f.\,T \pm g\,(T + W) + bv^2]$ will be the friction of the engine when moving with the resistances here indicated. And we have for the *sum of resistances* encountered by this engine, when referred to the track, $S = 1{,}699 + 116\,p + F + (1 + r)\,[f.\,T \pm g\,(T + W) + bv^2]$.

Let us reduce this equation for a velocity of 23 miles per hour, being the average speed of train No. 1 during 2·26 miles, the most unexceptionable on a level tangent as to attending circumstances; pressure in the boiler, as indicated by the steam gauge, being 124 lbs.

P = atmospheric pressure on pistons, in lbs.	1,699
$p = 8$; then $116\,p$ = ...	928
F = ...	348
$g = 0$.	
$f = 5{\cdot}7$ lbs. per ton gross.	
$T = 438 - 29 = 409$ tons gross.	
W = 29 tons gross.	
Frontage of train $= 110 + 28 \times 10 = 390$ sq. ft.	
$bv^2 = 390 \times 1{\cdot}6$ lbs. $= 624$ lbs.	
$1 + r = 1{\cdot}22$.	
Hence then $(1 + r)\,[f.\,T \pm g\,(T + W) + bv^2]$ =..............	3,605
and S =..........................	6,580

This amount of resistance is equivalent to the gravity on a grade of 35·3 ft. per mile, which is the *grade of double resistance* for this train at a speed of 23 miles per hour, with a steam pressure of 124 lbs.

Train No. 2, with the same pressure in the boiler, was removed 3·5 miles at the rate of about 20 miles per hour on a level tangent.

In the same formula

$$p = 6;\ \text{then } 116\,p = 696 \text{ lbs.}$$
$$S = 512 - 29 = 483 \text{ tons gross.}$$

Frontage and effective surface of train is $110 + 33 \times 10 \doteq 440$ square feet. $bv^2 = 440 \times 1{\cdot}2 = 528$ lbs.

Then S = 6,746 pounds.

Gravity will equal this amount of resistance on a grade of 31 ft. per mile.

Hence, then, other things being the same, we find that for train No. 1, moving with a velocity of 23 miles per hour, the grade demanding an outlay of power double the amount required on a level, is 35·3 ft. per mile. In other words, for this train, one mile of 35·3 ft. grade ascending would equal 2 miles of level line. While for No. 2, moving at 20 miles an hour, the power must be doubled on a grade of 31 ft. per mile.

Concerning the effect of velocity, we observe that with a load nearly one-fifth greater, the resistances are increased but 5 per cent. if the speed be reduced 43 per cent.

Thus, when a sufficient number of experiments have been made with care, it will be found valuable to prepare a table of results, and from this table the locating engineer may, with sufficient accuracy, determine the "equation of grades" for the class of road he is about estimating.

Though these reflections are independent of the experiments we are to consider, it is hoped they may not be thought useless. Nor will they, when it is remembered that important errors are frequently made by those who assume a constant quantity in "equating distances" on lines under investigation for estimates. So great is the error that not even an average can be made for trains presenting considerable differences in their composition.

In examining the data collected in a series of experiments on the effect of curvature, we shall notice greater departures from a formula based on any one, than in cases of grades on tangents. This will be the case in the present instances, for while on some parts of the road the track is properly prepared by bending to the curves, it is in other cases laid more carelessly, and is in some of the sharpest curves nearly straight. So that in passing from rail to rail the resistance from concussion is by no means inconsiderable.

In the following table will be found the results condensed of all the reliable data gathered on 200 miles east from Dunkirk. The cases are gleaned from the mass and averaged, a practice that, as before remarked, is dangerous, where entire accuracy is sought, yet one to which it is necessary to resort, unless the experiments are conducted with especial reference to this use. And even then the results obtained on various roads must be averaged for the construction of reliable tables for practical purposes.

The results are arranged to proceed from the simplest case to the most complicated, and are numbered as separate experiments, The first four in the list are the average of many observations, and are used as corrections for the curves.

To ascertain the effect of curvature we shall first examine the resistances opposed to each train as if on a tangent; then the total resistance actually overcome by the train on the various curves. The difference between these results will be the amount of resistance due curvature.

De Pambour's formula for the velocity at which a certain load may be drawn by a locomotive, is used with a change in the symbols for the convenience of those whose duties call them to know more of railroads than of the dead languages.

The formula will then stand—

$$V = \frac{\frac{1}{5{,}280} \cdot \frac{1}{q} \cdot \frac{1}{1+c} \cdot E}{(1 \pm r)\left[(f \pm g)\, T \pm gW + bv^2\right] + F + \frac{d^2\, l}{D}\left(\frac{n}{q} + a + 144p\right)} =$$

velocity in miles per hour, when—

E = effective vaporisation of the engine in c. ft. of water per hour.

q = factor expressing volume of steam proportioned to the pressure = ·00000023 when the pressure is given in pounds per square foot.

n = constant quantity relative to the volume of steam, its value being ·0001421.

l = length of stroke of piston.

c = clearance of the cylinder, equal in this instance to $\frac{1}{32}$ of the useful stroke of the piston, which gives $\frac{1}{1+c} = \frac{32}{33}$.

a = atmospheric pressure, equal to 2,117 lbs. per square foot.

d = diameter of cylinder.

D = diameter of driving-wheel.

The total heating-surface of the boiler = 1,105 square feet.

The diameter of blast orifice should have been stated at 3 inches.

The equation, when reduced by the substitution of these values, will read—

$$V = \frac{798\ E}{1{\cdot}22\left[(5{\cdot}7 \pm g)\, T \pm g\, W + bv^2\right] + 348 + 0{\cdot}8\,(2{,}736 + 144\,p)}.$$

To illustrate the use of this formula, let us apply it to the circumstances of Train No. 1. We shall have, by making proper substitutions, the equation

$$V = \frac{798 \times 210}{1{\cdot}22\,[5{\cdot}7 \times 409 + 624] + 348 + 0{\cdot}8\,(2{,}736 + 1{,}152)} = 23{\cdot}7 \text{ miles}$$

per hour.

It is thus we arrive at the amounts stated in the table under the head of "velocity demanded."

It is to be noticed, that in the experiments on level tangents, the actual effect is somewhat below the estimated powers of the engine; also, that as the velocity increases, the difference becomes greater.

This was, perhaps, to be expected. During a part of the time the adhesive power of the driver was affected by a leakage of the pumps, which wet the rail. The track is, moreover, exceedingly rough in places; though the quantity given above as the friction of the cars, being 5 lbs. per net ton, is in accordance with information received from the general superintendent of the Erie Road.

In addition to these causes of difference, it may be remarked that there was at times some wind; but as these are culled instances, it is believed they are free from any considerable influence beyond a quiet atmosphere. In No. 1, at a velocity of 22 miles per hour, there is a difference between the actual and possible effect of 3 per cent. of the work done.

In No. 2, at a velocity of 20 miles per hour, this difference amounts to 5 per cent.

In No. 3, the velocity being 8 miles per hour, the difference was too slight to be noted.

In No. 4, at a velocity of 7 miles per hour, the difference was equally unnoticeable.

Suppose there be similar relations throughout, these amounts must, for practical purposes, be applied as corrections to the experiments on curves.

If, therefore, the amounts in the column of differences be added to the velocity actually accomplished, and the sum be deducted from the velocity demanded, we shall have presented the effect of curvature, which in the table is noted as a fraction of the effect demanded, after correction.

General characteristic of line.	Number of the experiments.	Number of the train.	Grade—Ascent in feet per mile.	Alinement.	Total amount of curvature in degrees.	Boiler pressure indicated by steam gauge in lbs. per square inch.	Effective vaporisation in cubic feet of water per hour.	Velocity actually accomplished in miles per hour.	Velocity demanded by formula on tangent.	Difference for correction in miles per hour.	Difference due curvature expressed as a fraction of the effect demanded.
Level tangent	1	1	0	Tangent	..	124	210	23·0	23·7	0·7 } av. 0·8	..
....	2	2	0	Ditto	..	124	190	19·9	20·9	1·0 }	..
....	3	3	0	Ditto	..	130	141	8·0	8·0	0·0	..
Ascending tangent	4	2	40	Ditto	..	130	141	7·0	7·0	0·0	..
Level curve	5	1	0	1° Crv.	53	125	210	22·5	23·7	0·8	·01
....	6	2	0	3° Crv.	158	110	165	16·0	18·3	0·8	·08
....	7	1	0	Compound 1°, 2° and 3°..	85	120	165	18·3	20·0	0·8	·045
....	8	1	0	Ditto, 1¼° and 3°	82	120	165	17·9	20·0	0·8	·065
Ascending curve	9	1	24	1° Crv.	53	120	155	12·6	13·2	0·4	·014
....	10	1	40	4° Crv.	211	130	136	5·4	7·4	0·0	·27
....	11	1	40	3° Crv.	158	115	137	5·9	7·5	0·0	·21

It would be useless, of course, to found a law on these results. They are believed to be most carefully observed, and, so far as they go, are certainly correct. What are noted as single experiments, are really classes of observations. But we must have more considerable data from many roads before the results obtained can be made available for the purposes of the locating engineer, who, as before remarked, must be governed by the nature of the business to be done on the lines under consideration.

These results, however, are valuable; and, when other experiments have been made on broad gauge roads, will find their proper place among data of a like character.

NOTES BY A PRACTICAL CHEMIST.

ELECTROTYPE PROCESS FOR COATING BRASS AND COPPER WITH PLATINUM.—The bath consists of protoxalate of platinum. The objects are taken out from time to time, polished with whiting, and then replaced in the bath. The battery must be rather strong.

NEW GREEN DYE.—M. Verdeil has extracted a green pigment from the artichoke, totally distinct from chlorophyll. The plant is bruised and submitted to the joint influence of air, water, and ammonia. The flowers, especially the bases of the petals, are most productive. Hot water also extracts a rich green colour. When the colour is formed, the ammoniacal liquid is precipitated by acetic acid. The voluminous green precipitate is filtered, washed with hot water, pressed, and dried. It has then an appearance like indigo. Lakes may also be obtained with the metallic oxides.

ESTIMATION OF PRUSSIATE OF POTASH.—When permanganate of potash is poured into ferrocyanide of potassium, the former undergoes instantaneous reduction, and passes from crimson to bright green, then to a chesnut brown, and hydrated peroxide of manganese is finally deposited.

Mr. Slater proposes to employ this reaction in the volumetrical determination of yellow prussiate, since the usual impurities, alcaline sulphates and chlorides, exert no reductive action. The procedure is as follows:—a known weight of pure prussiate is dissolved in water, considerably diluted, and preserved as a standard. A solution of permanganate, prepared from the crystalline salt, is also required. Its exact strength at each operation should be determined by the standard solution. The solution of prussiate in question is placed in a wide shallow vessel over a small lamp, and the permanganate added from an ordinary graduated pourette. When the drops are falling into the prussiate no larger than an emerald, but a sea-green, the whole must be frequently stirred, and further additions made, with great care. When a green shade no longer appears the operation is complete; and by comparing the number of degrces of permanganate employed with the amount required for a pure specimen, the per centage of impurities will at once appear.

As the permanganate is without action upon the red prussiate, it may very conveniently serve as a test for regulating the manufacture of the latter. As long as a drop, when added, turns green, undecomposed yellow prussiate is present.

Preparation of Alcaline Stannates.—Digest litharge with a caustic soda lye containing 22 per cent. in a metal vessel. When dissolved, granulated tin is added. The lead separates whilst an equivalent proportion of tin is dissolved. The proportions are—

Tin	8 parts.
Soda lye, at 1·35	22·5
Litharge	35·

When the tin is dissolved the lead is allowed to subside and the liquid decanted. The lead when washed may be reconverted into litharge and employed again.

Other alcaline stannates may be prepared in a corresponding manner.

Chloride of Zinc Cement.—M. Sorel proposes for a cement basic oxychloride of zinc, prepared by moistening oxide of zinc with the chloride of zinc, or with that of iron, manganese, or hydrochloric acid. The more heavy the oxide and the more concentrated the chloride, the harder is the cement. To prevent it from setting too quickly, 3 per cent. of borax or sal ammoniac is added to the chloride.

The cement thus obtained may be run into moulds; it is of the hardness of marble, unaffected by cold, moisture, boiling-water, or a temperature of 576° F. The most powerful acids act very slowly upon it. To reduce the price, the oxide of zinc may be mixed with metallic, siliceous, or calcareous substances, *e.g.*, iron filings, pyrites, blende, emery, granite, marble, &c. Soft substances, such as chalk or ochre, will not answer.

This cement is capable of rceeiving the most vivid and various colours. Hence it serves for mosaics. It may be employed for statuettes, medallions, bas-reliefs, and for filling decayed teeth. It may also replace oil in painting. For such purposes the oxide of zinc, white or coloured as required, is moistened with water and a littlc size, and applied like ordinary paint. When the coats are all dry, chloride of zinc, at 25° to 30° Baumé, is brushed on, and dries instantly. It is hoped that in this manner the use of oils in painting may be entirely superseded. This would be desirable from a two-fold point of view. On the one hand we should save the land employed in the culture of oleaginous plants; and on the other, the injurious influence exerted upon a variety of colours by oils, during the process of drying, would be avoided.

ANSWERS TO CORRESPONDENTS.

"Vindex."—We have examined the cheap soap you mention and find it contains abundance of gelatine and other nitrogenous animal matter. It is, doubtless, made by boiling up the "whole hog," *i.e.*, by treating the carcases of putrifying animals with a soda lye. We understand that it excoriates the hands and communicates a disgusting odour to linen.

"A. L." (Lincoln).—The complaint against fish manures (artificial guanos) is that they encourage vermin.

AMERICAN NOTES, 1856.—No. I.

STEAM NAVIGATION.

New York and Havre Steam Ship Company.—The *Fulton*, the new steamer for this line to supply the loss of the *Franklin*, is rapidly approaching completion, she being advertised to leave New York on the 15th proximo. Her dimensions and particulars are as follows:

Length on deck	280 ft. 5 in.
Breadth of beam (molded)	42 „ 0 „
Depth of hold	24 „ 0 „
Depth of hold to spar-deck	31 „ 0 „
Length of engine and boiler-space	114 „ 0 „
Tons	2,500.

Kind of engines, inclined oscillating; ditto boilers, vertical tubular; diameter of cylinders, 65 in.; length of stroke, 10 ft.; diameter of paddle-wheel, 34 ft.; length of boards, 9 ft.; depth of ditto, 2 ft.; number of ditto, 28; number of boilers, 2, placed fore and aft; length of ditto, 30 ft.; breadth of ditto, 12 ft.; height of ditto, exclusive of steam-chests, 14 ft.; number of furnaces, 7; breadth of ditto, 3 ft. 6 in.; length of fire-bars, 7 ft.; number of tubes, 2,500 in one boiler, and 1,900 in the other; internal diameter of ditto, 2,500 of 2 in., and 1,900 of 2¼in.; length of ditto, 3 ft.; diameter of chimney, 6 ft. 8 in.; height of ditto, 41 ft.; area of immersed section at load draught, 630 ft.; load on safety-valve in lbs. per square in., 20; estimated revolutions per minute, 18; point of cutting off, one-half.

Combustion, natural draught: heating surface, 9,300 ft.; contents of bunkers in tons, 700; frames, molded, 20 in., sided, 10 in., and 32 in. apart; depth of keel, 8 in.; independent steam, fire, and bilge pumps, 2; masts, 2; rig, brig; intended service, New York to Havre; remarks, has her engines and boilers enclosed in a watertight compartment; hull, strapped with diagonal and double laid iron straps, 4½ in. by ⅝ in.

Steamer "Metropolis."—In my notice of this vessel (August, p. 183), I omitted to state that her engines and boilers were designed and superintended by Erastus W. Smith, Esq., of this city, the engineer of both the Havre and Bremen lines from this port. This was an omission which should not have occurred, and as my attention has been called to it, I hasten to make the correction and acknowledge my neglect.

Line from Japan to China.—The following are the particulars of the new steamer lately built in Boston for this route:

DIMENSIONS OF STEAMER "ANTELOPE."

Built by Samuel Hall; Engines by Boston Steam Engine Company, Boston. H.P. nominal.

Length on deck	155 ft. 0 tenths.
Breadth of beam	27 „ 6 „
Depth of hold to spar-deck	10 „ 6 „
Length of engine-space	36 „ 0 „
Tons	415

Kind of engines, vertical beam; ditto boilers, return flued; diameter of cylinders, 30 in.; length of stroke, 2 ft. 2 in.; diameter of screw, 9 ft.; pitch of screw, 19 ft.; number of blades of screw, 2; number of boilers, 2; length of ditto, 23 ft. 6 in.; breadth of ditto, 7 ft.; height of ditto, exclusive of steam-chests, 8 ft. 6 in.; number of furnaces, 2; breadth of ditto, 2 ft. 11 in.; length of fire-bars, 6 ft. 9 in.; number of flues, 15; internal diameter of ditto, 5 of 13 in., 8 of 9 in., and 2 of 18 in.; length of ditto, 18 ft. 4 in.; diameter of chimney, 3 ft. 6 in.; height of ditto, 22 ft.; maximum load on safety-valve in lbs. per square in., 25; contents of bunkers in tons, 75; draught forward, 10 ft.; ditto aft, 10 ft.; maximum revolutions, 58; frames, molded, 12 in., sided, 10 in., and 24 in. apart; independent steam, fire, and bilge pumps, 1; masts, 3; rig, brigantine; intended service, Japan and China.

New Line of Steamers.—The steam-ship *Mexico* (*United States* that was) left Havana on the 21st ultimo, for Sisal, Vera Cruz, and Tampico, in her new vocation and under the Spanish flag, to connect with the Spanish Ocean Line of Steamers, established by Zangrouniz Brothers, under Royal Charter. To sustain the main enterprise, which proposes alternate voyages to Liverpool and Havre, touching at Vigo and Porto Rico, out and in, business has to be created by the facility offered; it is not initiated under the pressure of an established trade, which is at present conducted by said vessels in direct communication. The problem is in course of solution, and if the force of means, industry, good vessels, and intelligent management will ensure success, it will follow.

Crystal Palace and American Institute.—The late aunual fair of the American Institute (the 27th) has just closed its exhibition, and concluded the award of its premiums at the building of the Exhibition of the Industry of All Nations, familiarly known as the Crystal Palace, and I am gratified at being able to announce that there exists the elements for a well-founded anticipation that this building will be purchased by this Institute, for an early occupation and continuance of the Exhibition of the Products of Industry, Art, and Science. The price asked for it is the moderate sum of 125,000 dollars, which includcs all the fixtures and moveables of the Crystal Palace Association, and if realised by them, will yet leave its creditors minus some 40 per cent. of their claims, whilst its stockholders will lose the entire capital stock, 486,000 dollars; in all, there will be lost by the Association 558,000 dollars, which loss, I am safe to assert, arose from the following causes:—

Firstly,—The location of the building was too far up town, that is, a visit there involved too great an expenditure of time and convenience to visit, for so business a community as that of New York and its vicinity;

Secondly,—The price of admission was put too low (50 cents.), as those who had the time or taste to go there, as a rule applicable to a very large majority, were able to and would have paid a larger price; whilst those who went because others went, and from a curiosity to see what it was like to, would not have staid away because of an increased price of admission, provided it was not an extravagant one;

Lastly,—Public taste at large was not up to the occasion for its display. Kiss's "Amazon," the "Sewing Girl," &c., &c., were all very pretty;—but with one class, promenading and shopping by day, and the opera in the evening, afforded much better opportunities for personal display than there were to be had at the Palace,—and with another class, labour by day was necessary, and Christy's minstrels in the evening were much more amusing.

Consequently it is not inexplicable that the Exhibition, in a pecuniary point of view, was a dead failure.

I select, from the "Inventor," the following notices of articles on exhibition at the late fair.

"The display in the mechanical department, which first comes under our notice, is far superior to any previous exhibition, and is particularly creditable from the fact that the articles in it are entirely of home manufacture, and will contrast favourably with similar productions of foreign make. Especially is this true of the machinists' tools, on exhibition from this city, Lowell, Paterson, and other places, equal in finish, and superior in design and arrangement to any from the long-established workshops of the old country. The railroad scales of Sampson's patent—appropriately named the mammoth—superior to any we have seen in the simplicity of their arrangement and the economy in their cost. A small oscillating engine by E. Morris, of South Bergen, N.J., is commendable for an improved and ready-acting reversing gear. A fine assortment of ships' chronometers by Calvin Kline, and also by D. Eggert and Son, both of this city, are especially noticeable for their beauty of workmanship in a branch of the art in which we have been dependent, heretofore, upon foreign makers. Samples of forging, for locomotives, by the Paterson Iron Company are commendable for their smooth and finished appearance. A large-sized slotting-machine, with a variety of other tools, by Carpenter and Plass, of New York, are well worthy an inspection. The automatic grain scales, from Ohio, causes a great deal of curiosity, and is constantly surrounded by a crowd of visitors; it is said to be capable of weighing accurately 25,000 bushels of grain per day. It is an ingenious machine, and we should think a good one. A variety of machines for economising labour in carpentry are on exhibition, comprising dove-tailing, morticing, sawing, planing, and shaping machines, many of which are great improvements in their line, and well calculated to accomplish the purposes for which they are designed. The show of agricultural implements is varied and extensive, embracing many important improvements for the saving of labour in farm-work. The dry goods department is well filled, and is said by competent judges to show a steady improvement over former years."

MISCELLANEOUS.

I have seen lately specimens of rare mechanical genius. In the first case a machine, costing not over 500 dollars, invented by a working man, which, after receiving a sheet of brass, copper, or iron, turns out complete hinges at the rate of a gross in ten minutes; hinges, too, neater than are made by any other process. In the second, a machine that takes hold of an iron rod and whips it into perfect bit-pointed screws with great rapidity, and by a single process. This is also the invention of a working man; and both these machines are superior to anything of the kind yet attained. No other process of manufacture can compete with them.

Liberal Incentive to Mechanics.—The following letter, from a liberal manufacturer of this country, is not devoid of interest to the mechanics of England, as a fair field is open to them for competition:—

Tinmouth, Vt., Oct. 1, 1855.

MESSRS. QUIMBY, HASKELL, & Co.

I will give 15,000 dollars for a machine that will saw or plough slate in the ledge, of any required size, for roofing purposes. The sizes vary from 6×12 to 18×36 inches. The object is to cut a series of grooves the required distance apart, and then traverse them at right angles. The grooves *must* be from 1 in. to 1½ in. wide, and 6 in. in depth, at the least. *Wider* and *deeper* ones may be used, if thought necessary by the inventor to carry out his design. The object of the wide grooves is to give room to fasten an iron hook into the block after it is cut, and lift it from its bed in the ledge. The present manner of getting out slate is by blasting with gunpowder, wasting more than one-half of the stone, and requiring great care and skill to prepare it for use for roofing.

There are three things of importance to be gained by the use of such a machine.

1st. Lessening the present expense, and facilitating the getting out the slates from the ledge, and fitting them in a better shape and manner for the roof.

2nd. A saving of 50 per cent. in the present loss of material.

3rd. Lessening the liability of breakage in transportation, as they may be carried to market in blocks as they are sawed out of the bed, and split up into proper thicknesses by the workmen who lay the roof.

The inventor who produces a machine that will do this, properly and economically, will make his fortune, and link his name for ever with the imperishable slate and marble hills of the "Green Mountain Slate."

Communications (which will be strictly confidential) may be addressed to me at my residence, and will be promptly attended to. Models and plans may be sent by express (prepaid) to Wallingford, Vt., and will be returned, after examination, on the receipt of an order from the owner.

Respectfully yours, &c.,
MARCUS P. NORTON.

New Door Lock.—Messrs. Holmes, Valentini, and Butler, of New York, exhibit, for the first time, a new lock, the patent for which is only just out. It is a very ingenious affair, so arranged, that if you put in the key and simply push, the door instantly opens, no turning of knob being required; and, on the other side, if you simply pull a knob, egress is just as easily obtained. The arrangement of parts is very simple and effective, while, for convenience, the improvement is wholly unequalled.

This lock is guaranteed by the makers to be secure against the attacks of the most skilful lock-picks. For dwelling-houses, store-doors, &c., it possesses the advantage of rendering useless the huge clumsy key now in use, as the key is so small that a dozen of them may be carried in the vest pocket. From the peculiar construction, millions of changes may be made in the form; and it becomes almost an impossibility for any two locks to be alike.

H.

ON THE APPLICATION OF VOLUTE-SPRINGS TO THE SAFETY-VALVES OF LOCOMOTIVE AND OTHER BOILERS.*

By J. BAILLIE, communicated by MR. R. STEPHENSON, M.P., V.P.

The volute-spring, stated to have been invented by Mr. Baillie, the locomotive superintendent of the Central Hungarian Railway, was described to consist of "a single plate of steel, wound spirally in a conical shape, sustaining pressure and deflection in reference to its breadth instead of thickness, and was constructed of thicker and deeper plates, according to the increased strength desired.

"The effect attained by this form of applying steel to resist pressure was found to be such, that equal loads were sustained by one-third the weight necessary for elliptical springs of like capabilities and power.

"From the peculiar mode in which the rigidity and elasticity of the material was applied in these springs, although so very light, they were not liable to break, or to be injured by any amount of force, if properly fitted; and the experience of upwards of seven years had proved that they were very economical for all railway purposes. The same experience had proved the unfitness of caoutchouc, or other substitutes for steel, for mechanical application, where great wear and tear had to be sustained, whilst the elliptical form of spring had many disadvantages, which were obviated by the direct action, the compactness, and the elasticity of the volute; and the saving effected by their adoption was not only in the first cost, which was great, but also in repairs, owing to the simple construction and application of the volute; whilst, in addition, much of the iron-work necessary in fitting ordinary springs was saved."

It was stated that the volutes had been adapted not only to an immense number of locomotive engines, both abroad and in England, but also to tenders, waggons, trucks, and carriages, for bearing, buffer, and traction springs, and in all cases with decided advantage, as to space and durability, over the ordinary elliptical springs. They were also now beginning to be employed as auxiliary springs for common road carts and waggons; and they were proved to be very valuable for many kinds of machines liable to sudden pressure, such as any unyielding substance passing between rollers, which would otherwise almost inevitably be fractured.

Concurring in the almost universal opinion, of the inadequate dimensions of the safety-valves being the most fruitful cause of explosions, and, at the same time, appreciating the practical difficulties attendant upon increasing the number, or the area of the ordinary valves, with the present system of weighting them, Mr. Baillie determined to try whether a safety-valve of large area could not be conveniently and steadily held down by a number of volute-springs of known power; this appeared to act extremely well, and in order to test the new system, in comparison with the ordinary method, a safety-valve of 12 in. diameter, held down by seven volute springs, was adapted to a locomotive boiler, on which there was also an ordinary valve of 3·6 in. diameter, weighted with the usual lever and spring-balance. The boiler possessed an area of heating surface of 890 square feet, but lest the cylinders should take too much steam, the engine remained stationary during the experiments, and the fire was urged by a constant jet of steam, of half an inch diameter, into

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* Extract of a Paper read, and discussion thereon, at the Institution of Civil Engineers, November 27, 1855. Our readers will find Mr. Baillie's volute-spring illustrated at p. 100, Vol. x. (1852).

the chimney. The two valves were equally weighted to a pressure of 64 lbs. per square inch. The large valve was then fastened down, and in four minutes the pressure of the steam had increased to 105 lbs. when the small valve had risen 1-12th of an inch, and the experiment was stopped, as the valve could not discharge the steam so fast as it was generated.

The small valve was then screwed down, and the large valve was set free; in four minutes the pressure had only increased from 64 lbs. to 76 lbs. per square inch, or 12 lbs., when the valve rose 1-24th of an inch; and although the fire was powerfully urged for upwards of half an hour, the pressure of the steam could not be raised beyond 76 lbs., as the large area of the safety-valve allowed all the steam that was generated to escape freely.

These experiments were considered so satisfactory, that the system of using volute-springs for the valves had been generally adopted for the boilers of the locomotives of the Hungarian and Austrian railways, upon which Mr. Baillie was engaged.

In order to commence the discussion, a "Description of an Improved Form of Safety-Valve for Steam Boilers," by Mr. J. Fenton, M. Inst. C.E., was read by the Secretary.

The object of this valve was the prevention of accidents, arising from the liability of the ordinary mushroom-shaped safety-valves to stick fast; this was effected by making the valve spherical, with a hemispherical seat, a hemispherical cup bearing upon the ball valve; this cup was connected to the valve-lever by a spherical joint; all the other joints of the lever and attachments being also on the ball and socket construction, so that all were free to move in any direction, and no sticking of any part was possible. A model of the single valve and diagrams of both single and double valves were exhibited; the latter were so arranged, with a single lever, as to act as a lock-up valve and an open valve combined, both being equally limited to the maximum pressure of the lock-up spring. A considerable number of these valves had been in use for some time, with decided success; they afforded a considerably greater seeurity than the ordinary safety-valves, without greater expense of construction, and it was anticipated that they would be more durable than the ordinary valves, and be quite as easily repaired and kept in order.

In a recent letter to Mr. Kirtley, it was stated by Mr. Baillie, that eighty-one engines on the Hungarian and Austrian lines were carried upon volute-springs, and it was intended to alter all the others as opportunity offered. Double springs had been generally used for the middle bearing, but it was no now considered necessary, as some engines with single springs appeared to be quite as steady, and not to receive greater shocks than the others. The great point to be attended to was, that the volutes should not be overloaded, nor be screwed down too tightly. A volute of steel $5\frac{1}{4}$ in. broad and $\frac{7}{32}$ in. thick should not be loaded with more than 20 cwt., nor one of $4\frac{1}{4}$ in. broad and $\frac{7}{32}$ in. thick with more than 15 cwt., and it would be still better if their loads were reduced to 18 cwt. and $13\frac{1}{2}$ cwt. respectively.

Great attention should be paid to the due and proportionate loading of the springs under an engine, and the engine-driver should be strictly prohibited from altering the position of the nuts on the holding bolts of the springs, as, besides injuring the volutes, an undue weight must be thrown upon the other axles, and damage would ensue to the machine as well as to the rails.

With the ordinary flat springs, it was difficult to ascertain exactly what pressure was put upon them by altering the screws; but with the volutes a certain law was obtained, which rendered evident the absolute pressure to which they were subjected. Each spring was depressed a certain distance by a given weight, say, for instance, those of certain dimensions would be depressed a quarter of an inch by 6 cwt.; so that if the spring was originally $8\frac{1}{4}$ in. high when unloaded, it would, under a weight of 18 cwt., have been reduced to $7\frac{1}{2}$ in. in height; then by trying and marking the trial weights upon the volutes, and regulating them accordingly, there could not be any error in computing the pressure upon them.

The weighbridge for ascertaining the exact weight upon each wheel had been generally adopted with good effeet, and to prevent the enginemen from altering the weight upon the springs, some thin washers were placed between the cross-bar and the eollar upon each holding bolt, which precluded the possibility of tampering with it. The effect of this regulation had been, that the engine-springs rarely required to be meddled with, and very few fractures occurred, unless the railway was in a bad state.

The reason for employing such heavy engines for the conveyance of passengers was that there was only one train of that kind per day, and one mixed train of passengers and goods at night; the former weighing about 160 to 180 tons, and running at a speed of thirty miles an hour, and the mixed train weighing from 250 to 270 tons, travelling twenty-four miles per hour. The bulk of the traffic consisted of goods, of whieh from 60,000 to 70,000 tons were conveyed per month along the railway from Szegedin and Szolnok to Vienna, a distance of 304 English miles, which length it was intended to extend to Weiskirchen, about 140 miles further to the south-east of Szegedin.

An illustration was given of the adaptation of the volute-springs to hydraulic safety-valves for equalising the pressure on water-mains and obviating the injurious effects of the concussion caused by the oscillation of the column of water. This system, which had been introduced by Mr. Croker, for the Amsterdam Waterworks, was easily adjusted to a head of 170 ft., representing a pressure of 39·2 lbs. per square inch, or a total load of 1,970 lbs. on the valve; it had been in use for six months and might be perfectly relied upon.

The arrangement was very simple, consisting merely of a vertical branch of 8 in. diameter, springing from the horizontal main pipe of 6 in. diameter; on the top of the branch pipe was fixed a valve and seat of gun-metal, so arranged, that upon the lugs were fixed the wrought-iron bolts holding the cross-bar, between the underside of which and the top of the valve was placed a volute-spring of about $2\frac{1}{2}$ tons pressure; the exact pressure was regulated by adjusting bolts provided with stop-nuts, and the apparatus could be accommodated to the required head with great facility and precision.

Drawings were exhibited of the *Wien Raab* locomotive engine, constructed by Mr. John Haswell, locomotive superintendent of the Vienna and Raab Railway, and sent to the Exhibition of Industry at Paris, in 1855. The chief characteristics of this engine, which was intended principally for the goods traffic, were its having outside cylinders, inside framing, aud eight wheels, all coupled. As the distance between the axles of the leading and the trailing wheels was 12 ft., it was necessary to have special arrangements for enabling this great length to pass curves of short radius; this was accomplished by allowing the bearings of the trailing-axle and its coupling-rods to have a lateral motion of eighteen lines; and in the trials upon the Sömering inclines, of 1 in 40, it was found that this engine would draw up a load of about 110 tons, at an average speed of nearly twelve miles per hour, passing with facility round curves of as small a radius as 600 ft.; the motion of the eugine being inuch steadier than that of any others of the same power. When evaporating 200 cubic ft. of water per hour, the engine could draw, on a level, a load of 1,047 tons, at a speed of about $14\frac{1}{2}$ miles per hour.

The engine, with the water in the boiler, weighed 34 tons, and the division was so arranged, that no wheel pressed with more than 4·4 tons weight upon the rails—a great superiority over other engines tried upon the line, as in some cases the weight was as much as 7 tons upon one wheel, which would suffice to destroy the heaviest rails, and the ultimate effect was, that when the permanent way became uneven, the jerks were so severe, that the springs could not prevent them being seriously felt by the engine, the structure of which was soon dislocated.

The fire-box was arranged for burning wood or turf, but, with a trifling modification, could be adapted for coal or coke, and the spark-catcher was like that of the American engines.

All the chief working parts were so placed as to be fully in sight, and were easily accessible for examination, for oiling, and for repair; this desirable end was attained by employing the space within the frames, formerly, and in other engines, occupied by the pumps and slides; the frames were firmly connected together by strong transverse stays, offering great resistance to lateral strain, and at the same time rendering the frame much stronger with less weight of material, whilst the opposite axle-boxes were as firmly connected together as if they were formed out of one piece of metal.

The guides for preventing the lateral oscillation of the wheels and axles were placed in the centre, betweeu the axle-boxes; and between the side-plates was a guide-block, working upon a pin, on the same level as the axle traversing the guides. By this arrangement it became possible for one wheel to rise or fall without the frame of the engine being strained.

The volute-springs which were used for bearing the weight of the engine were placed withinside the frame, and in consequence of the arrangements already described, could be fixed considerably lower than the ordinary flat springs, thus obtaining the great advantage of lowering the centre of gravity.

The centre guard was omitted for the hinder, or sliding axle, and in order that the springs might not interfere with the requisite lateral motion, the lower ends of the bolts, by whose upper ends the engine was suspended upon the springs, were allowed to turn with the play of the axle.

The wheels were cast-iron discs, with cast-steel tires.

The boiler was of the ordinary construction, and had adapted to it a safety-valve with a large aperture, held down by the volute-springs, by which any aceumulation of pressure of steam beyond 8-10ths of an atmosphere above the maximum working pressure was effectually prevented. In praetice this had been found to offer an effectual protection against accidents arising from carelessness or daring, and the system was now adopted for all the engiues on the railway.

REVIEWS.

Dr. Muspratt's Applied Chemistry.

(Continued from page 292.)

Chloroform, the author remarks, affords an excellent instance how purely theoretical researches may often prove of the most eminent practical importance. The manner in which the properties of chlorine are masked in this compound is very striking. It no longer bleaches; it does not precipitate nitrate of silver; and when boiled with nitric acid exerts no action upon gold.

Its powers as a solvent, upon iodine, bromine, camphor, caoutchouc, wax, amber, copal, and the resins, are employed both in analysis and in the arts. As an anæsthetic the author gives a caution, in which we heartily concur, against its promiscuous and unnecessary employment. It is only in grave operations, and where all tendency to apoplexy or to disease of the heart is absent, that its use is legitimate. Many fatal accidents are undoubtedly due to impurities and adulteration. Bye-products of an absolutely poisonous nature are often generated, especially if the chloroform be prepared from methylic spirit, which the manufacturer is unable or unwilling to remove. It is indeed stated that some years ago a certain firm sent the *impurities* to market, and threw the chloroform away. Alcohol, ether, aldehyde, hydrochloric and hypochlorous acids may easily be recognised by the appropriate tests. The two former, when the sample is treated with bichromate of potash and sulphuric acid, reduce the chromic acid, and produce a distinct green colouration. Aldehyde may be recognised by its reducing the hydrated oxide of silver. Hydrochloric acid gives the well-known white precipitate with soluble salts of silver, whilst hypochlorous acid first reddens and then bleaches litmus.

For the methylic compounds there is, unfortunately, no direct test, save their action upon the system. We cannot refrain from expressing the hope that some restriction will be placed upon the sale of chloroform and similar anæsthetics. No person should be supplied with these substances unless he can show that he has some lawful use for them.

The notice of "Cider" includes the mechanical as well as the chemical points involved in its preparation. The remarkable immunity which the cider counties, Devon and Hereford, have enjoyed during the two visitations of cholera in 1832 and 1849 is mentioned, although the author is not prepared to ascribe this result to the beverage of the district. His opinion of cider is very favourable. One passage in his eulogium is, however, rather obscure. Comparing ciders with ales, he remarks that the former contain *lactic* instead of acetic acid.

The adulteration of cider and perry with lead is next noticed, the article concluding with this very just remark: "Vile adulterations are not to be stopped by heavy penalties and stringent laws, means which have failed; but the only true remedy is the extension of chemical knowledge."

Folio of Plates of Machinery of the British and North American Royal Mail Steam Ship "Arabia," and of the West India Royal Mail Steam Ship "La Plata."—Constructed by R. Napier and Sons. Drawn and executed by David Kirkaldy. Printed and published by Wm. Mackenzie, Edinburgh.

We have so recently received the above work that we cannot, this month, do full justice to its excellence.

The plates are engraved in an admirable manner from the drawings of Mr. David Kirkaldy, whose name is well known to the engineering world as one of the best draughtsmen of the present day, and to whom was awarded a medal by the jurors at the distribution of rewards allotted to the City of Glasgow for works exhibited at the Paris Exposition—a medal for the excellence of the drawings executed for Messrs. R. Napier and Son, and exhibited by that firm.

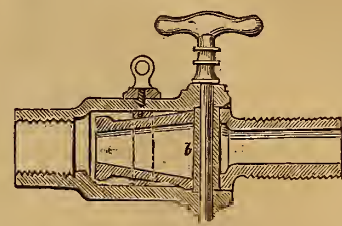
The letter-press description and tabulated matter appear to us to be very carefully given; but next month, we intend to notice this work at length, and more in consonance with its merits.

RECENT PATENTS.

Ezra Miles, *of Stoke Hammond, Bucks, for an improved coupling-joint or connexion for tubing or other purposes.*—[Dated 12th January, 1855.]

The following is an extract from the specification of this invention, and which, aided by the diagram, will be readily understood.

The Fig. represents the improved coupling in longitudinal section. It consists mainly of two tubes, called by the patentee "male and female parts,"—which tubes are connected together at *b*, by a pin. *a*, is a moveable or rolling packing-ring, slipped over the conical nose of the male tube. The patentee remarks that, "Although I propose to use rings of india-rubber, or of vulcanised india-rubber, yet I do not confine myself to those materials; and in some cases, where highly-heated fluids are employed, I use rings formed of flax, hemp, or of some similar fibre, woven, twisted, or spun, either alone or impregnated with chemical materials, for giving them a degree of mobility or elasticity. And I especially use a method of tightening rings made of canvas or of any vegetable fibre, woven, twisted, or spun, and preventing them from slipping or rolling over the lip of the cone. Thus, while an india-rubber ring, when stretched over the lip, contracts immediately and cannot escape, an ordinary fibrous ring, if large enough to pass over the nozzle of the male joint, would slip off. I therefore, after-fitting on the fibrous ring, dip it into a cold concentrated solution of caustic soda or potash, by which means contraction takes place, and it can no longer pass over the lip."



William Smith *and* Thomas Phillips, *both of Snow-hill, for Improvements in cocks or taps, and in balls or floats to be used therewith.*—[Dated 19th January, 1855.]

These improvements are described in the specification of the patentees, as follows:—

Fig. 1 shows in longitudinal section, and Fig. 2, in transverse section, a cock or tap constructed according to this invention. This cock is arranged more

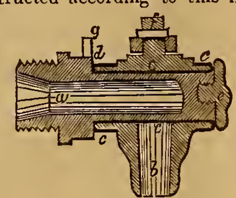


Fig. 1.

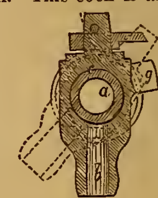


Fig. 2.

especially to be used with a float or ball, and closed or opened by the rising or falling of the liquid in the reservoir which it is intended to fill. *a*, is the plug of the tap or cock, which, according to this arrangement, is stationary,—there being a screw-thread, *a*, formed thereon, to facilitate its connexion to the supply,—but this mode of connexion may be varied. *b*, is the barrel, which, in this case, is the moving part, and it carries the outlet-passage, *b*; *c*, is a lining of vulcanised india-rubber between the parts, *a* and *b*. This lining, it will be seen, is of a tubular form, and somewhat longer than the barrel, *b*; it also has an opening in its length at *c*, corresponding with the outlet-opening in the barrel, *b*, to the passage, *b*. In applying the tube, *c*, to the barrel, it is placed therein with its ends projecting beyond each end of the barrel,—and those projecting ends are then turned over, as shown, on to the parts, *b*, of the barrel, which are in form to receive them; and it is preferred to have the interior of the barrel and the surface of the parts, *b*, roughened, as thereby the india-rubber is better held in position from any tendency to slip: and in most cases it will be better, when the cock or tap is of cast metal, simply to leave these parts in the condition obtained by the casting—whereby, in addition to the advantage in use by the better holding of the india-rubber thereto, a saving of labour in the construction will be effected. When the barrel, with its india-rubber lining, is applied to the plug, the turned-over ends of the india-rubber tube will be prevented shifting, partly by the projecting rim, *d*, and partly by the projecting head of the screw, *e*, which screw also retains the parts together; and the only parts of the tap or cock necessary for its correct working to be turned truly, are the surfaces of the parts, *a*, *d* and *e*, which rub against the inside and turned-over surfaces of the tube of vulcanised india-rubber, to avoid friction and rubbing thereto. And in place of forming such taps of brass or mixed metals, they may be readily formed of malleable cast-iron, at considerably less cost.

It will thus be seen that in use, the water or other fluid will pass in at one end of the hollow plug, *a*,—and when the openings in the barrel, *b*, and tube, *c*, to the passage, *b*, are opposite to the opening, *a*, in the plug, *a*, such water or other fluid will flow out by the passage, *b*; but when the barrel is turned partly round with its india-rubber lining, *c*, as shown by Fig. 2, that lining will close the opening, *a*, and no fluid will flow therefrom. When using such cocks with balls or floats, the arm or lever of the float is applied to the part, *f*, and a stop is attached to such arm, to act against a stop, *g*, on the fixed part of the tap, to prevent the parts turning too far.

The patentees remark that cocks or taps thus formed, with the barrel capable of turning on a stationary plug, are especially adapted as ball-cocks, to open and close by a float, as the outlet for the fluid passing through being thereby caused to change in direction with the float, will prevent the flow falling on the float to interfere with its free operation.

Fig. 3, shows an external view of another tap or cock, but with the barrel stationary, and the plug turning therein for the flow. The water or other fluid will flow into the barrel of the tap or cock by the passage, *b*, and thence out therefrom at *a*.

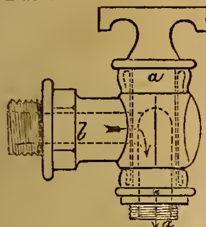


Fig. 4.

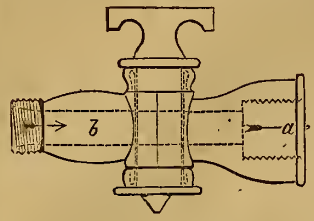


Fig. 3.

Fig. 4, shows an arrangement of cock suitable for the flow of gas or other such aëriform fluid. In this case, the outlet from, as well as the inlet to, the cock, is in the barrel, as indicated by the arrow, though the flow may be in the opposite direction; and the passage from one part to the other of the barrel is through the plug, *a*.

The floats are formed of galvanised iron, or of tin plate galvanised, in place of copper, by which considerable economy is effected in the manufacture; and it is preferred to form them of a figure composed of two cones united at their bases—but this may be varied. The two parts of the float are placed together, and united by turning over the edge of one part upon the edge of the other, commonly called "seaming," or by any suitable means. They are subsequently immersed in a bath of molten tin or zinc, or other suitable soft metal, by which they will receive a coating thereof, and be retained together watertight.

George Hamilton, *of* 86, *Great Tower-street, for Improvements in Obtaining Soundings.*—[Dated 18th October, 1854.]

This invention consists in attaching by a hinge-joint to the fore part of a ship or vessel a metal or other bar, so arranged as to trail on the bottom when the depth of water is small. To this metal bar is attached an indicator, by means of which the depth of water is indicated as soon as the ship gets into shallow water. The trailing-bar may be so arranged that it can be raised out of the water, that it may not impede the progress of the vessel when there is no chance of its being required.

Fig. 1, shows a side-view of the apparatus complete, except the trailing-bar. Fig. 2, shows another side-view of the fixing parts, with the other or upper parts in a position at right angles to that in which they are shown in Fig. 1. Fig. 3, is part plan of some of the parts; and Fig. 4, shows the upper part of the trailing-bar. *a*, *a*, is a clamping-frame, by which the apparatus is fixed to the taffrail or other part of a ship or vessel by means of the screws, *b*, and moving-plate, *c*. On the upper part of the frame, *a*, is fixed the axis, *d*, which carries the other parts of the apparatus, and allows of their moving thereon, so as to come correctly in position for use. *e*, is a forked arm, which at one end turns freely on the fixed axis, *d*, and at the other end the forked arm carries the axis, *f*, in suitable bearings, *g*, *g*. On this axis, *f*, there is a saddle-piece, f^1, on which the forked end of the trailing-bar is placed, as shown at Fig. 4. On the axis, *f*, is the arm, *h*, which acts as a counter-balance to the pointer, *i*, fixed on the axis, *f*, as shown. *j*, is an axis, fixed to the socket or boss of the forked arm; *k*, is a graduated arc, which moves freely on the axis, *j*, and is kept counterbalanced by the weighted arm, *l*, fixed thereto. This arc may be graduated on both sides, so as to employ two different lengths of trailing-bars therewith, but ordinarily one trailing-bar will be sufficient, in which case only one graduation will be necessary. Supposing this apparatus to be fixed to the fore part of a ship, or, in fact, in any convenient part of a ship, and the trailing-bar is in position, the depth of water will be indicated by the pointer and graduated scale, and which will assume positions according to the angle of the trailing-bar for the time being.

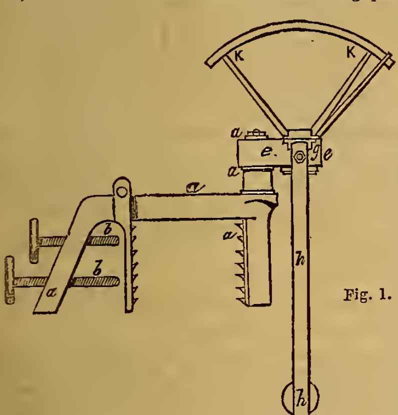


Fig. 1.

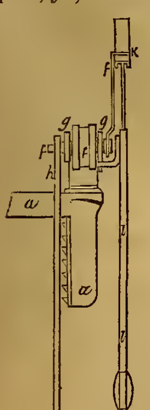


Fig. 2.

FIG 4

FIG 3

Charles Jared Hunt, *of the Willows, Mitcham, in the county of Surrey, for Improvements in Tug and other Hooks.*—[Dated 10*th* May, 1855.]

This invention has for its object improvements in tug and other hooks with a view to make them open out more fully, and, consequently, to release when subject to a direct pull. For this purpose a tug or other hook is made of three parts, which are hinged or pin-jointed together. The stem, which constitutes one part of a hook, is made with a swivel eye or otherwise, as may be desired. At the lower end the second part of the hook, which receives the strain, is connected by a pin-joint, and to this part the third part is pin-jointed. The other end of this third part is made in such a manner as to be securely held to the stem of the hook by means of a cylinder, which is capable of rotating near the upper part of the stem, and it is constantly pressed on by a spring. So long as the hook is in use the parts are all held securely, but immediately on requirement, by moving up the cylinder and moving it partly round, the point of the hook will be released, and by reason of the hook being in three parts it will open out so as to completely release whatever it may previously have held.

Fig. 1, shows a side-view; and Fig. 2, is a section of a tug or hook constructed according to my invention. *a*, is the stem to which the proper eye or swivel is applied, or other form of instrument by which the hook is to be applied to the stem, *a*; the intermediate piece, *b*, is attached by a pin-joint, and to the intermediate piece is attached the part, *c*, and this part, *c*, at its other end is to be formed and arranged in respect to the other parts in such manner that it may be held securely when in use, and yet capable of being easily and readily released when it is required to release the trace or other instrument held by the tug or hook. For this purpose I prefer to use the hoop or band, *d*, which can turn freely round on the stem, and between it and the eye, *c*, fixed thereto. This hoop has a notch in it, so that when this notch is at a distance from the point of the hook, the hook will be held secure, but when by turning this hoop the notch comes opposite the point of the hook, the hook will be released and the trace or other instrument attached to or held by the hook will be readily freed by any strain thereon. The hoop has on it a projection, *x*, and the hoop is pressed towards the point of the hook by a spring, hence, in use, the hoop will be retained from movement by the part, *x*, entering the notch, *f*, on the fixed collar of the stem. In order to release the point of the hook the hoop is moved back on the stem so as to draw the part, *x*, out of the notch, and then the hoop can be readily moved round on the stem so as to bring the notch in the hoop opposite the point of the hook.

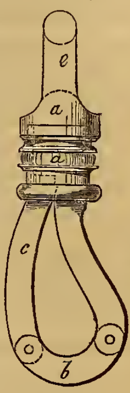


Fig. 1.

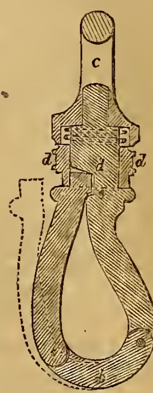


Fig. 2.

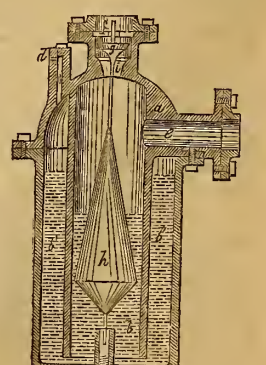
The inventor adds: "Having thus described the nature of my invention, and the manner of performing the same, I would have it understood that I am aware that tugs or hooks have before in some cases been made, each of two parts connected by a pin-joint at the bend or point where the strain when in use comes; I do not, therefore, claim such construction.

"But what I claim is, the construction of tugs or hooks by a combination of parts, *a*, *b*, *c*, as herein described."

Samuel Bickerton, *of Oldham, Lancashire, for an improved gas-light governor or regulator; which invention is also applicable to regulating the supply of water and other fluids.*—[Dated 11th August, 1854.]

The construction of this regulator is made apparent by the following diagram and the Fig. accompanying.

Fig. *a*, *a*, represents the metal case; *b*, the inner division; b^1, the outer division; *c*, feed-pipe for admission of water or other fluid, closed at the top by a screw; *e*, inlet pipe; *f*, outlet pipe; *g*, valve; *h*, float; and *i*, valve-box. The top part of the case has a tube or pipe, *b*, passing down its centre, so that when the two parts of the case are fitted together the lower end of the pipe is nearly at the bottom of the tank, thus dividing the case into two parts or divisions, communicating with each other by the space between the end of the pipe, *b*, and the bottom of the tank. The small pipe, *c*, projects from the top part of the case, and has a small opening, *d*, at the side, to allow atmospheric pressure in the outer division, b^1. The inlet pipe, *e*, passes through the outer case, *a*, and conveys directly into the inner division or pipe, *b*, the gas or fluid to be regulated. If the fluid be gas, it at once fills that portion of the pipe or inner chamber, *b*, not already occupied with a denser fluid, such as water, which has been previously admitted through the pipe, *c*, and partly fills the inner and outer divisions.



The pressure of the gas on the fluid in the inner division works the apparatus in the following manner:—The outlet pipe, *f*, being closed, the pressure of the gas depresses the water in the inner division, and the float falls, bringing down with it the valve, *g*, into the valve-box, *i*. On turning on the burners, and thus opening the outlet pipe, *f*, the pressure of the gas on the fluid in the chamber, *b*, is diminished, the fluid rises, taking with it the float, *h*, and thus raises the valve, *g*. This action and reaction is rendered more complete and delicate by the float, *h*, being of nearly the same specific gravity as the fluid in which it is placed. The actiou of the gas against the valve, *g*, in passing to the burners, also has a tendency to raise the valve and float—the form of the latter, as well as its specific gravity, favouring this result. It is thus evident that the more buruers there are put in operation, the pressure on the fluid in the inner division is diminished, and the more gas escapes through the outlet pipe, *f*; and, on the contrary, on any of the burners being suddenly turned off, a proportionate pressure is thrown on the fluid in the inner division, and the valve descends with the float. The apparatus may be described as an inverted syphon, one leg of which (the inner division, *b*,) is open to the pressure of the gas or other fluid to be regulated in supply, while the other leg (the outer division, b^1,) is in communication with the atmosphere.

CORRESPONDENCE.

CARR'S PATENT STEERING APPARATUS.

Patent dated 28th August, 1854.

To the Editor of The Artizan.

SIR,—The novelty of this invention consists, in the addition to the ordinary steering apparatus, of an eccentric (or its mechanical equivalent, the crank) working in conjoint combination with an entire pulley (or its segment, a quadraut) on a vertical axis of their own, the whole being interposed, as a medium of connexion, between the ropes or chains and the tiller, for the double purpose of protecting the steersman and economising his power.

In plate lxiv., Nos. 1, 2, and 3 are three modifications of this apparatus, of each of which two views are given. The lower views are, in each case, plans showing a portion of the quarter-deck, of which D D is the longitudinal centre or midship line; the upper views are sectional side-elevations through the centre of the vertical axis, quadrant, &c. All the views, with exception of plan of No. 3, show the apparatus in the position it would occupy when the rudder is in a line with the keel, the tiller showing the position of the rudder, with which it is parallel. The corresponding details in the three modifications are marked with corresponding letters. The scale to which the drawings are made is half-an-inch to the foot.

No. 1 shows the arrangement in which an eccentric, of the usual form, is made use of.

This eccentric, A, is mounted horizontally, and turns freely on a vertical stud or axis, B, on which it is secured from rising by the cap, C. The axis itself (which is cast hollow for lightness) has a flange on its base, by which it is bolted fast to the deck, a few feet on one side from the longitudinal centre of the vessel or midship-line, D, D. To the under side of the eccentric, near its outer edge, the arc of a quadrant, E, is fixed, so that the two revolve in a piece on the same axis. To each end of this quadrant the ropes from the wheel-shaft barrel, F, are attached, after passing through the pullies, G, G, G, which latter are secured in brackets to the deck, with their lower edge on a level with the quadrant. Two of these pullies are for one rope, and a single one for the other. The eccentric is also fitted as usual with a strap or ring on its rim, from which ring the arm or eccentric rod, H, projects, the extremity of which is jointed to the tiller, K, which tiller is made about one-fourth longer than the amount of eccentricity of the eccentric.

Thus it is apparent that when the wheel is turned, the ropes acting on the quadrant of the eccentric must cause the latter partially to revolve on its axis and thus to traverse the tiller, but to a less extent than the eccentric itself does, owing to the tiller being, as before stated, one-fourth longer than the amount of eccentricity of the eccentric.

Plan No. 1, so far as the details of its mechanism goes, being now, I trust, sufficiently understood, No. 2 will be still more readily explained, as it is merely a modification of the former, in which the general arrangement and mode of application remain the same, the only alteration consisting in the simple reduction of the eccentric, for the sake of greater lightness to its elementary base, the crank, which gives, of course, precisely the same motion. The eccentric, as it is scarcely necessary to mention, being itself merely a crank, the pin of which has been enlarged sufficiently to embrace its axis of rotation.

In No. 2, therefore, it will be seen the axis, B, is bolted to the deck in the same relative position as in No. 1; the quadrant, E, also, is the same, the fulcrum of which turns freely on the axis as before. On the upper side of this quadrant a pin, A, stands up, fixed tight in the centre radius of the quadrant, at a distance from its fulcrum, answering to the eccentricity of an eccentric of a similar amount of throw. To this pin one end of the connecting-rod, H, is attached, the other end being jointed, like the eccentric rod of No. 1, to the tiller, K, which, as in the former case, is about one-fourth longer than the crank. It is obvious, therefore, that in turning the wheel the tiller will be traversed, as in the former plan.

Plan No. 3 is the same as No. 2, with the exception of the arrangement being made more compact and central by dispensing with the connecting-rod in favour of its ordinary substitute; ou such occasions a slot is formed iu the tiller for the crank-pin to work in. An entire pulley also is there used to work it, instead of, as in Nos. 1 and 2, a segment of one, or quadrant, as it is termed.

The upper view, like all the preceding ones, shows the apparatus in the position it would be in when the rudder and tiller are in a line with the keel, but the plan view below, in this case, shows it in that it would occupy when the helm is hard over.

In this arrangement the vertical axis, B, is secured to the ship's counter, directly abaft the rudder-head, L, on the midship line, D, D. On this axis is mounted, as before, the rope quadrant, or, as here shown, entire pulley, E, near the periphery of which, at a part cast solid for the purpose, the vertical pin, A, is secured, which is connected to the tiller, K, by passing up through a sliding-block, which works freely in its slot. When the tiller is amidships, as in the upper view, the pin, A, is also so, and at the outer extremity of the slot; but, as the pulley revolves, the pin slides down the slot, forcing out the tiller to an angle in doing so, till the latter has attained its utmost travel, by which time (as shown in the plan view) it is so arranged that the latter should have become at right angles to a radius line passing the centres of the axis and pin, instead of parallel with it, as it was when amidships. The length of the tiller, or rather its average length, as it is in this case a varying one, is made longer in proportion to the crank than in Nos. 1 and 2, in order (for reasous hereafter to be explained) to make the number of degrees traversed by the crank exceed that of the tiller in a still greater proportion than in the former arrangements. Two eye-holes, it will be seen, are made in the end of the tiller, through which ropes could be rove to convert it at once into the ordinary steering apparatus in case of anything going wrong, and a hole is left in the rudder-head, L, for the insertion of a hand jury-tiller to hold it by while doing so.

I briefly sum up the advantages this apparatus appears to me to possess:—

Firstly,—Owing to the travel of the eccentric, or crank, being much greater than that of the tiller, the leverage increases as the sine of the rudder with the keel increases, so that where the man has the greatest resistance he has the greatest power to overcome that resistance.

Secondly,—It effectually protects the steersman from the dangerous shocks occasioned by what is termed the "kicking of the rudder," or, in other words, the spontaneous revolution of the wheel when the rudder is struck by a heavy sea while at an angle with the keel; for, when the rudder is hard-over, the apparatus has come on its dead centre with the tiller, and is then moveable only at the will of the man; thus, the further the helm is brought over the less tendency has it to revolve the pulley, and, consequently, the steering-wheel.

Thirdly,—It keeps the ropes always in one straight line, and at a uniform tension throughout, leaving no slack for back-lash, or loss of time in winding up; the reverse of which is another great defect in the ordinary steering apparatus.

Fourthly,—It involves no complicated mechanism, requiring a delicacy of construction, nicety of adjustment, and difficult to keep in order and repair; but is, on the contrary, simple, durable, and efficient under all circumstances.

Fifthly,—The mechanism itself becomes substantially strongest when most strength is required, for when the rudder is hard over the parts subject to the strain are brought in a direct line, thereby placing them in the most favourable position possible for sustaining it with impunity.

Sixthly,—In case of anything going wroug, the apparatus is not at all iu the way to prevent it being converted at once into the ordinary steering apparatus, for which purpose it would be well, in Nos. 1 and 2, to extend the tiller beyond the joint; No. 3 is already long enough for the purpose without this extension.

Seventhly,—It is very easily applied, and at a small cost, to the old apparatuses of existing vessels; and

Lastly,—Owing to its non-liability to injure the steersmau, and its increasing his leverage when he has the greatest resistance to overcome, one mau is capable of working it at all times without assistance; a great desideratum, especially when a vessel is short-handed in a storm, when the full strength of the crew is urgently required elsewhere to ensure the safety of the vessel.

I am, Sir, your obedient servant,

Stackhouse, Settle, Yorkshire. THOMAS CARR.

ON THE SLIP OF PADDLE-WHEELS.

To the Editor of The Artizan.

SIR,—In your notice of the experiments made with the United States' steam frigate, *Mississippi* (Vol. xiii., November, 1855, p. 260), to ascertain the effect of twenty-one and eleven paddles respectively upon the slip of the wheel, it is stated that the slip, when steaming with tweuty-one paddles was 12·79 per centum, and with eleven paddles 25·74 per centum.

Will you allow me to inquire how much greater was the power expended by the engines in the second case than in the first?

1855. I am, Sir, your obedient servant, D.

[As the experiments above alluded to were undertaken to determine the influence upon the slip of the paddle-wheels, which the removal of a certain number of the paddle-floats would have in relation to the transmission of the power, the total power of the engines was not a uecessary element of observation. The proportionate slip is exactly indicated by the *per-centages*, and relatively remains the same, whether the engines at the time of the trials were developing the same or different powers, so long as the conditions were similar. The consumption of coals, &c., was not given. On referring again to our November Number, p. 260, "D" will find all the informatiou with which we were furnished.—ED.]

SHORT AND LONG STROKE MARINE ENGINES.

To the Editor of The Artizan.

SIR,—Much has been written and said about the disadvantage of a short stroke iu direct-acting marine engines. Now, in the case of engines for driving the screw-propeller, I should imagine that the engines will make a greater number of revolutions with a short than with a long stroke, as the speed of the piston will be about the same in both cases; and it now is the one thing needful in screw-engines to gain a high speed. For instance, suppose that there be two screw steamers, both of the same build and burthen, and that each has a pair of engines of 100 H.P., and that the engines of one are 40 in. diameter and 20 in. stroke, while the other's engines are 36 in. diameter and 24 in. stroke; all other things being equal, there is not the least doubt but that the first will prove herself the fastest vessel, as, in the first case, there is a larger force to drive the piston a short distance, and in the second there is a smaller force to drive it a greater distance; and supposing the speed of the piston to be 200 ft. per minute, the first will make sixty revolutions while the other will only be fifty. It is the opinion of some that engines with a loug stroke will make as many revolutions as with a short stroke. That being the case, of course the contents of the cylinder are increased, and therefore more steam will be required, unless the engines be worked expansively, which, after all, is doubtful economy. Another objection is the increased friction said to be produced. Now, as during the same number of revolutions one piston will travel over more space than the other, it must therefore meet with more friction.

The experience that the Admiralty have had shows that they prefer a short stroke, as all the screw steam-ships lately built for them, and those now fitting out, have been fitted with short-stroke engines, the usual ratio being to make the stroke rather more than half the diameter.

If reference be made to the tables at the end of Murray's "Rudimentary Treatise on the Marine Engine," it will be seen that the greatest number of revolutions was made by the engines of the *Encounter*; with two cylinders of 55 in. effective diameter and 27 in. stroke they made 78 revolutions. The engines of the *Niger* made 74·3 revolutions; she has four cylinders of 47$\frac{5}{8}$ in. diameter and 22 in. stroke. The engines of the *Conflict* made 68 revolutions; she has four cylinders of 46 in. diameter and 24 in. stroke. The engines of the *Vulcan*, 66·5 revolutions; she has four cylinders, 49$\frac{1}{4}$ in. diameter and 24 in. stroke. All these engines made more revolutions at their trial-trips than any others, thus showing what a short stroke can do. The same tables show, that with the exception of those vessels fitted with high-pressure and geared engines, these vessels made the greatest speed of any. Thus, the *Encounter* made 10·254 knots; the *Niger*, 10·427; the *Conflict*, 9·289; and the *Vulcan*, 9·665. These statistics practically show the advantage of a short stroke.

I should be glad to hear the opinions of some of your correspondents on this important subject; and if you could find space to publish this letter in your columns you would confer a favour upon

Your obedient Servant,

London, Nov. 30*th*, 1855. STUDENT.

VERTICAL BOILERS.

To the Editor of The Artizan.

SIR,—I here forward you a sketch of a vertical boiler for publication in your valuable work, THE ARTIZAN, if such has not been brought before the public already, and should you deem it worthy a place in your publication.

The great object which it is desirable to obtain for this kind of boiler is a simple method of cleansing the bottom ends of the tubes. I have known a boiler of this description to be rendered useless (and had to be taken out of its place to be supplied with a new tube-plate) in less than three months from the time it was first set, although the water was not considered bad for other boilers.

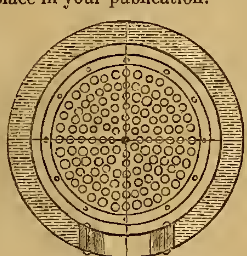


Fig. 1.

The plan I here beg to propose is one which, I think, will effect the object required at a small cost; and, although the first cost of the boiler will be more, of course, than if made on the old plan, yet the durability of an article of this kind is the chief thing to be considered.

Your readers will see that the tubes and tube-plates will not be subject to strain, as is the case with all tubular boilers at present. Those tubes can expand and contract freely without straining any other part of the boiler.

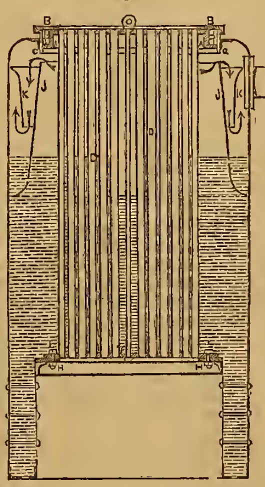


Fig. 2.

The following letters represent the different parts:—

a, the body of what I have named the piston, which is of *wrought-iron*, with a metallic packing (any other packing may be used if found to answer the purpose better); *b*, a wrought-iron junk-ring or piston-cover, which has a flange to lap over what may be termed the cylinder, *c*, which cylinder is also intended to be of wrought-iron, and bored out to receive the piston; this said flange or junk-ring is intended to support the end of boiler in case a great pressure of steam should be required; *d*, represents the tubes which may be fastened in the regular way; *e*, centre stay-bolt, which has an eye at top end for lifting out the tubes —as many stay-bolts may be used as should be thought necessary; *f*, bottom tube-plate, which is intended to fit on ring, *g*, over the fire, and made steam-tight; tube-plate, *f*, is intended to have brass nuts, *l*, *l*, let into it to receive the screws, *h*, *h*, so that they can be more easily removed when required; *i*, steam-pipe; *j* and *k* are thin sheet-iron rings or cylindrical pieces for the prevention of priming, which are highly necessary for this kind of boiler, and which may be made stationary.

I see no reason why a piston of this description should not be adapted with an advantage to a locomotive boiler as well as to the vertical boiler. I can see no difficulty in making the piston keep perfectly steam-tight, in case it should be introduced for that purpose. THOMAS MERITON.

THE ENGINES OF "THE JASON."

WE this month present our subscribers with a double plate (lxii.), being a plan of the engines and boilers of the screw steam-ship *Jason*, the plate (lviii.) given in our Number for November being a longitudinal section of the engine-room, exhibiting the engines, boilers, screw-slip, &c. The present plate will make the arrangement and disposition of the several parts readily understood.

We are prevented by the want of space this month from saying more with reference to these admirable specimens of engineering skill.

RUSSIAN GUN-BOATS FOR THE BALTIC.

Plate lxiii.

WE this month present a plate of the Russian gun-boats, as designed by the engineers of the Russian Government in 1852-53, and which were to have been fitted by Messrs. Rennie and Sons with disc engines and boilers, arranged as exhibited in the accompanying plate.

The arrangements were affirmed by the Russian Government, and but for the probabilities of war, at that time impending, a small flotilla of these gun-boats, armed and powered as shown, would have been built in this country.

Our limited space this month will prevent our giving further details, but in our next we hope to be enabled to give some further particulars of these and other gun-boats.

NOTES AND NOVELTIES.

GUTTA PERCHA.—This remarkable substance, which was brought to Europe so recently as 1844, has become an article of great importance and utility in the arts. It is now applied to many practical purposes, but none of them of so general interest, or of so much importance, as that of pipes for conveying water for domestic use. Its peculiar properties, among which, as of the first importance, may be named its insolubility by water, acids, salts, and alkalies, and, consequently, freedom from deleterious effects on water, render it one of the best, if not the very best of materials for that purpose. One most important quality in any material for water-pipes is strength. On this point there has been but little information in regard to gutta percha. Many trials have been reported in this country and in England, but generally they only indicated that a pipe had stood a certain pressure, and would answer a certain purpose; they did not give the ultimate strength of the material.

Some careful experiments were made in this city a few days since, at the works of Messrs. J. J. Walworth and Co., to ascertain the absolute strength of various sizes of pipe, by applying pressure until the pipes burst.

The apparatus was constructed expressly for the purpose by Messrs. Walworth, with great care, and was itself tested by comparison with a steam-gauge.

The following table shows the pressure sustained by the different pipes, and the load on the safety-valve when the pipes burst. The results indicate that gutta percha possesses enormous strength, and that pipes may be made of this material strong enough for any service required of them:—

Inside diameter of pipe.	Pounds to square inch.	Burst at.
$\frac{1}{2}$ inch.	stood 370	390
1 ,,	,, 350	370
1$\frac{1}{4}$,,	,, 200	210
$\frac{5}{8}$,,	,, 320	580
$\frac{1}{4}$,,	,, 1,000	1,080

The first three are such as are in common use for aqueducts and suction. The $\frac{5}{8}$ is the kind made for service pipes for the Boston Waterworks. The trial of this was imperfect. The $\frac{1}{4}$-inch pipe, made for soda fountains, sustained, uninjured, the great pressure of 1,000 lbs. to the square inch.—*American Railroad Journal.*

BERTHON'S INDIA-RUBBER OR FLEXIBLE MORTAR-BOAT.—The Rev. Mr. Berthon, so well known by all who have had any interest in fitting out our steam fleets, both royal and mercantile, for his "Log" for steam-ships, has made another contribution to practical science in the shape of a flexible mortar-boat. We think the idea a good one; and, when worked out well and to its legitimate extent, will be a valuable acquisition to the shipping interest. The present suggestion is, that a flexible vessel, formed of india-rubber or gutta percha, supported on iron or wood frames, can be made so strong, and yet so flexible as well as portable, as to be easily stowed away in any convenient place on board ship, and brought out when and where required. The following extract from the "Portsmouth Telegraph" will be read with interest: —"In the early part of the week, the india-rubber mortar-raft, invented by the Rev. Mr. Berthon, of Fareham, was towed out of harbour two or three times for trial. These trials are incomplete; but we hear that this invention has exhibited some remarkable and valuable qualities. It is made to collapse; so that a line-of-battle ship would be able to carry four or five to sea, and, lowering them and their mortars, soon have the whole in order for work. The delay in navigating them to the Baltic or Black Sea would thus be avoided, and therefore would be at the scene of action at the beginning of the campaign instead of the middle of it; whilst so much haste and anxiety would be obviated as to their return home. In addition to this, they would be admirable things for landing troops in an open beach, or for crossing rivers, especially as regards cavalry. They possess other valuable and available qualities.

READ'S PATENT SCREW WRENCH.—Fig. 1 is a perspective view, showing how the wrench is used in screwing up a tube-joint; Fig. 2 is a longitudinal section through the centre, showing the parts where the wrench is ready for operation; Fig. 3 is a section, showing the pawl free from the teeth in the moveable jaw, to allow the latter to be adjusted, contracted, or expanded. The same letters refer to like parts on the three figures.

The nature of the invention consists in having the shank of the adjustable jaw pass through a recess attached to a stationary jaw by a pivot, and the shank of the moveable jaw provided with a rack, into which a pawl catches to retain it in proper position.

A is the metal stock of the wrench, and B is the handle; C is a metal clasp, pivoted at *a* to the stock A; E is the moveable jaw, having a shank, D, with teeth, *h*, on its inner edge. This stock works in a recess, *e*, in the clasp, C, and is retained in any part of this recess by the pallett, F. The head of the shank, A, is serrated, and forms the stationary jaw of the wrench, opposite to the moveable jaw, E. *e b* are two small division-pieces in the inside of the clasp, C, between which the pallet, F, works; they are, therefore, guides to it. *g* is a flat spring secured at *f* (Fig. 1) to act under the tongue of the pallet, F, and retain it in place to hold the moveable jaw firm while being used.

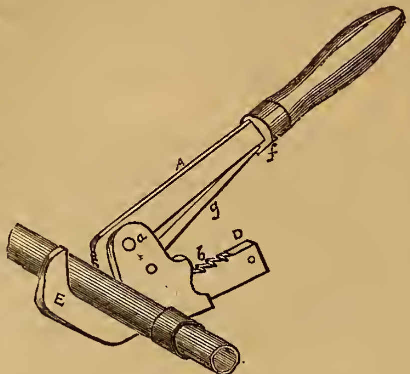


Fig. 1.

Operation.—If it is desired to open or expand the jaws of the wrench, the handle, A, and the inner end of shank, D, are pressed together between the thumb and fingers, so as to squeeze them into the position shown in Fig. 3; this act makes the spring, *g*, slip further into the pallet, F, which relieves it, and allows it to assume the position shown—viz., freed from the teeth, *h*. The shank, D, of the moveable jaw, E, can then be pushed further in or drawn further out of the clasp recess, *e*, to expand or contract the jaws—increase or lessen the space between E and the serrated head of the stock. The pallet, F, springs into place when the stock, A, and shank, D, are relieved of the squeezing pressure. In using the wrench to expand or contract the jaws, it is held in the hand with the moveable jaw on the upper side, and not on the under side, as shown in the Figures.

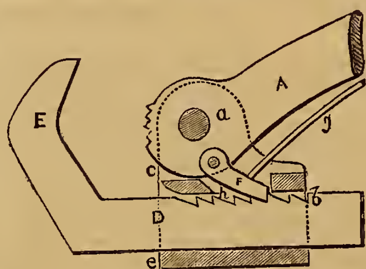


Fig 2.

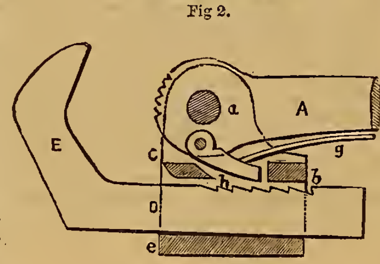
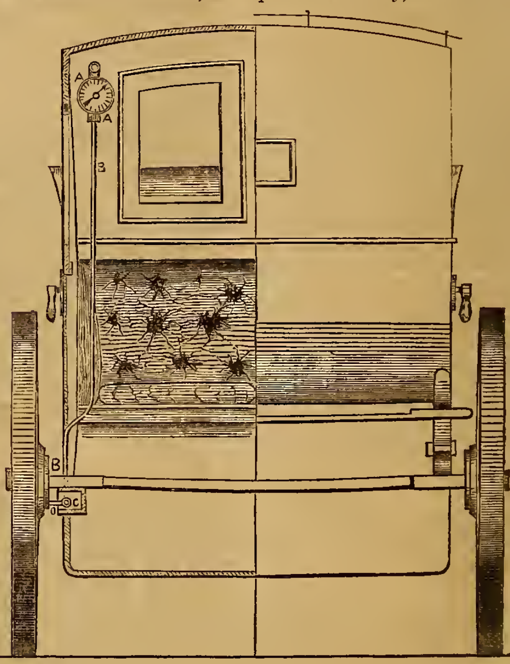


Fig. 3.

By this arrangement of the jaws of the wrench, their tendency is to press firmly upon a nut or other object, while the handle, A, is being turned. The moveable jaw is prevented being drawn out by a pin inserted in it near the end of the shank. It will be observed, that while the jaws are acting on a square nut, or on a round object like the tube, Fig. 1, their leverage is expected to keep the pallet, *f*, in the teeth of shank, D, and thus they are held remarkably firm to work. Owing to their particular form, and relative position also, they will not slip on a nut, and they can retain within their grasp a round as well as a square object; this is a valuable quality in a wrench. As has been explained, this wrench can readily be adjusted to operate on nuts, bolts, and tubes of different sizes and forms.

POSITION OF ALUMINIUM IN THE VOLTAIC SERIES.—Having, through the kindness of Dr. Hoffman, been permitted to examine a specimen of aluminium prepared by M. Claire-Daville, I availed myself of the opportunity to ascertain one of the physical properties of this extraordinary metal, which it does not appear has yet been determined—viz., its order in the voltaic series. The following are the results of my experiments:—Solution of potassa acts more energetically and with a greater evolution of hydrogen gas upon aluminium than it does upon zinc, cadmium, or tin. In this liquid aluminium is negative to zinc, and positive to cadmium, tin, lead, iron, copper, and platinum. Employed as the positive metal, the most steady and energetic current is obtained; when it is opposed to copper as the negative metal, all the other metals negative to it which were tried became rapidly polarised, whether above or below copper in the series. In a solution of hydrochloric acid, aluminium is negative to zinc and cadmium, and positive to all the other metals above named. With this liquid also, copper, opposed to it as the negative metal, gave the strongest and most constant current. Nitric and sulphuric acid are known not to act chemically in any sensible manner on aluminium. With the former acid diluted, as the exciting liquid, aluminium is negative to zinc, cadmium, tin, lead, and iron. The current with zinc is strong; with the other metals very weak; and it is probable that their apparent negative condition is the result of polarisation. When aluminium is immersed in dilute sulphuric acid, it appears negative to zinc, cadmium, tin, and iron; but with lead, on which sulphuric acid has no action, the current is insensible. In both these liquids copper and platinum are negative to aluminium, and, notwithstanding the apparent absence of chemical action on the latter metal, weak currents are produced. It is rather remarkable that a metal, the atomic number of which is so small, and the specific gravity of which is so low, should occupy such a position in the electro-motive scale as to be more negative than zinc in the series.—*Professor Wheatstone, communication to the Royal Society.*

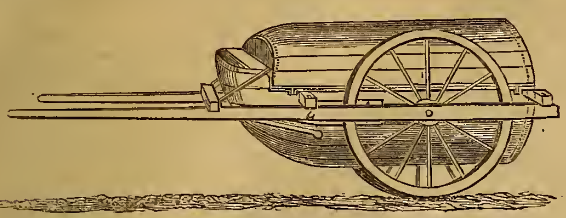
NORTON'S PATENT PNEUMATIC DISTANCE OR MILEAGE INDICATOR, for measuring and registering, upon a simple and unerring principle, the distance travelled by carriages and other vehicles. The diagram here given illustrates one of the forms in which this instrument is applied, and is shown as only indicating miles and furlongs. A is the indicator, which may be suspended in any convenient part of the carriage; the dial is divided into miles and furlongs; at the top of the instrument, or in any convenient position, a cord is attached, and, under the control of the driver alone, is used to detach the internal arrangement of the apparatus, and bring the pointer back to O before starting. B, a flexible tube, to connect the air-box, C, with the instrument. C, small iron air-box attached to the axle. D, a pin, stud, or cam, attached to the nave of the wheel, which acts upon the air-box each time the wheel makes a revolution, forcing the air through the flexible tube, and so acting upon the instrument, A. The box, C, being attached to the axle, and it being connected to the instrument by a flexible pipe, is not affected by the oscillation of the body of the vehicle. Mr. Norton also applies his patent instruments to various other purposes—viz.: as indicators for registering the speed of machinery, steam-engines, &c.; as a distance indicator for land surveying; also, as a pedometer, for measuring the distance walked or run, and registering from 1 furlong to 20 miles and upwards. This simple and ingenious instrument measures, with perfect accuracy, the distance travelled



by carriages upon the common road—the miles and furlongs being exhibited upon a dial in plain figures. The instrument can be suspended in any part of the carriage. It cannot be tampered with, and is not liable to become deranged by ordinary wear, or by the vibration and concussion common to travelling over paved streets. It is equally applicable to the private carriage, the public cab, omnibus, or other conveyance. To the public who employ cabs, the introduction of this instrument will be a great boon, preventing the disputes which so frequently arise between the cab driver and the passenger; and much as the recent public Act and police regulations, as well as the re-measurement of the London thoroughfares from the Post-office, have each in their way tended to simplify such vexed questions, yet it remains for this instrument to be adopted, to enable the public, more especially ladies, to avail themselves to the fullest extent of cabs as a means of public conveyance. And when it is stated that all the passenger will have to do is to see that the index of the instrument stands at O on entering the vehicle, and if not so, to merely request the driver to set it, which is all the control he can exercise over it; thus, it will be seen that the matter is exceedingly simple, and may be readily understood by any one. Norton's Patent Indicator may be worked from any convenient part of the wheel of the carriage to which it is applied, the distance from the spring block to the nave of the wheel being given, the diameter of the nave, and the precise circumference of the wheel from which it is to be worked.*

* We have tested the correctness of the action of one of these instruments for nine months, and found it work very satisfactorily.

AMPHIBIOUS BAGGAGE-WAGGONS.—The South of Russia, the probable scene of operations for our army during the next campaign, being much intersected by rivers, it would seem that amphibious baggage-



waggons might be found useful; we therefore give a sketch of a vehicle of this description, as devised by the late Sir Samuel Bentham, supplied by Prince Potemkin to a Corps of Yagers. Though provided in no greater number than is usual in the Russian Army for the carriage of stores, these waggons sufficed to convey the regiment across a stream, their covers being used as boats. They were contrived in consequence of the success that had attended ship-carriages for private service, the first of which had been constructed by Sir Samuel in 1782 at Count Strogonoff's Fabric, in the Ural Mountains. An engraving of this vehicle was given in the "United Service Journal" for 1829, page 581. Sir Samuel, afterwards, built others for the use of himself and *suite* in Siberia, and travelled in them between 30,000 and 40,000 miles, crossing rivers without taking off the wheels, the horses swimming, thus being ready-harnessed to resume the traction of the carriage on arriving at the opposite shore.

These baggage-waggons were not adapted to the convenience of mounted artillery in 1830; however, Sir Samuel devised amphibious vehicles for this purpose; unfortunately, no drawing or description of them has been found, but the idea being given, British skill and science are fully competent to the carrying it into execution.

THE "MARLBOROUGH," 131, SCREW, got up steam for the first time to test her machinery, on the 15th ult., in the steam basin. On the pressure in the six boilers reaching 20 lb. to the square inch (the maximum to which the safety-valves are loaded), no symptoms of leakage were apparent, and shortly after ten o'clock, when steam was first admitted to her ponderous cylinders, these leviathans started into motion smoothly, silently, and to the admiration of all present, and thus continued for several hours, the maximum number of revolutions attained being forty-two, with steam of 15 lb. pressure, and throttle-valves only partially open. The engines of this, the largest ship afloat, have been constructed by Messrs. Maudslay, Sons, and Field, of a similar form to those of the *Princess Royal*, 91, gun-ship, but much larger in proportion, the cylinders being 82 in. in diameter, with a stroke of 4 ft., the connecting-rods taking immediately into the main line of shafting, to which is affixed the screw-propeller, in this instance, of over 19 ft. in diameter, with a pitch of 26 ft. 9 in. It is surmised that in the trial trip of this vessel, which is expected to take place shortly, a speed of over twelve knots per hour will be realised, which will throw into the shade even the performances of the great *Duke of Wellington.* Should the number of fifty revolutions be attained (which is fully anticipated) the *Marlborough's* speed will be close upon thirteen knots, with steam at 15 lb. instead of 20 lb.; throttle-valves half open. The nominal H.P. of her engines is 800; they weigh, with their boilers, about 600 tons, but occupy less space than those in the *Duke.* Mr. John Davey is her chief engineer (first class).

ANSWERS TO CORRESPONDENTS.

"COCHLEN," Islington.—Your engineering friend in the City is in error The *Himalaya* has never had, we believe, a screw with three blades. About six months ago her original screw with two blades had one of them broken, and Government forwarded another screw, also double-bladed, of the same diameter and pitch.

We think Messrs. Summers and Co. did cast a three-bladed screw for her, but certainly it has never been fitted.

DIMENSIONS OF NEW STEAMERS OR SAILING VESSELS.

THE CANADIAN OCEAN STEAM NAVIGATION COMPANY'S NEW IRON SCREW-PROPELLER STEAM-VESSEL "ONEIDA."

Built by Messrs. John Scott and Son, Greenock; machinery by Messrs. Scott, Sinclair and Co., Greenock, 1855.

Dimensions—Builders' measurement.	ft. inches.
Length of keel and fore-rake ...	305 0
Breadth of beam	39 0
Tonnage.	Tons.
Hull	2,323 $\frac{27}{94}$
Engine-room	835 $\frac{93}{94}$
Register	1,387 $\frac{48}{94}$
Customs' late measurement	ft. tenths.
Length on deck	311 4
Breadth at two-fifths of midship depth	37 9
Depth of hold at midship	27 1
Length of engine-room	115 1
Tonnage.	Tons.
Hull	2,317 $\frac{3}{100}$
Engine-room	1,279 $\frac{41}{100}$
Shaft-tunnel	30 $\frac{53}{100}$
Register	1,007 $\frac{9}{100}$

Fitted with three inverted cylinder direct-acting engines of 440 nominal H.P. Diameter of cylinders, 58 in.; length of stroke, 3 ft. Screw-propeller: diameter, 18 ft.; length of ditto, 2 ft.; pitch, 35 ft.; has three blades. Four tubular boilers: length, 9 ft. 6 in.; breadth, 18 ft. 3 in.; depth (exclusive of steam-chests), 16 ft. Twenty furnaces: length, 7 ft. 3 in.; breadth, 3 ft. 1,400 tubes, or 350 in each boiler; diameter, $3\frac{1}{4}$ in.; length, 7 ft. Chimney: diameter, 8 ft. 4 in.; length, 40 ft. Steam-pressure, 18 lbs. per square inch. These engines have their own separate connecting-rods and cranks, dividing the strain or jerk more equably on the propeller-shaft; and on the trial trips worked very smoothly, and without that tremulous motion perceptible in other screw-vessels, and ran the distance from the landing-stage, Liverpool, to Dublin, a distance of 138 miles, at a draught of 22 ft. water, engines making thirty-eight revolutions per minute, in eleven hours, being at the rate of 12·6 miles per hour average; and from Dublin to Malta in nine days, a distance of 3,822 miles, or thereabouts, being heavily laden. Has never been off duty since, being chartered by the Government. Steams from eight to nine knots an hour with two boilers. Before being converted into a transport-vessel, was fitted up with accommodations for 180 first and 400 second-class passengers, both cabins being fitted up with every requisite for the comfort of passengers, &c. Was built for the Liverpool, Quebec and Montreal line of steamers, and the largest iron screw-propeller steam-vessel ever built in Greenock, and is a first-class vessel, being very strongly built, and of an approved model for speed and for carrying large cargoes. This vessel has exploded the idea held by the Government in regard to iron vessels not being adapted for warlike purposes, as the following despatch received from Lord Alfred Paget, respecting operations near Eupatoria, on the 22nd day of October, proves that this vessel has successfully withstood the most severe test. "The *Oneida* accompanied that expedition, and Captain Hamilton, of the *Diamond*, frigate, of 36 guns, knowing his vessel (a sailing one) could not operate with the land force so satisfactorily as he desired, transferred the guns from the *Diamond* into the *Oneida*, from which he fired on the flanks and advanced pickets of the enemy with complete success. This is the first instance on record of heavy marine artillery being fired from an iron vessel."

The machinery of this vessel is from the designs of George W. Taffrew, Esq., manager for Messrs. Scott, Sinclair and Co., the makers of the machinery, &c.

DESCRIPTION.

A demi-female figure-head; no galleries; round-sterned and clinch-built vessel; clipper-bow; standing bowsprit; three decks, flush; three masts; ship-rigged.

Port of Liverpool. Commander, Mr. Digby Brokeby Morton.

W. F. B.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 18th July, 1855.

1609. Théophile Louis Marie Riot and Sylvain Guillaume Paul Dehais, Paris—Improvements in the treatment of silk.

Dated 28th July, 1855.

1715. Charles Emile Paris, Paris—A new material to be used in the manufacture of crystal, enamel, and other similar products.

Dated 29th August, 1855.

1953. John Hanson, Doagh, Belfast—Improvements in machinery or apparatus for digging or working land, and removing roots or plants therefrom.

Dated 6th September, 1855.

2019. James Fraser, Jermyn-street—Improvement in the manufacture of paper.

Dated 8th September, 1855.

2032. Robert Barnard Feather, Liverpool—Improvements in the make and construction of shells and balls to be used with cannon, or other artillery, or fire-arms.

Dated 18th September, 1855.

2104. James Dellagana, 61, Red Lion-street, Clerkenwell—Stereotyping type high, that is to say, as high as common printing type, or seven-eighths of an inch high.

Dated 9th October, 1855.

2252. Ellis Rowland and James Rowland, Manchester—Improvements in locomotive steam-engines.

2259. Narcisse Leroy, 15, Rue de l'Eglise, Batignolles, Paris — Improvements in the construction of railway carriages.

Dated 11th October, 1855.

2273. William Andrew Fairbairn and George Haslam, Manchester — Improvements applicable to locomotive engines and carriages.

2275. Peter Spence, Pendleton—Improvements in the production of sulphate of alumina, to be used in the fluid state, or to be rendered into the solid condition, known commercially as cake alum.

2277. John King Westrop, Staining-lane, and Edward Alfred Sharman, 35, Noble-street—Improvements in the manufacture of gloves made of looped fabrics of silk, cotton, and linen.

Dated 12th October, 1855.

2279. John Clark, Strand—Cooking apparatus for the pocket.
2281. Robert Henry Kay, and Alfred Thomas Richardson, and George Mallinson, Manchester—Improvements in the manufacture of plain and ornamental woven fabrics.
2283. William Lyall, Amiens—Improvements in spinning machinery, applicable also to roving machinery.
2285. Henry Gardner, Oldner Farm, Chipping Norton—Improvements in machinery for dressing or cleaning wheat, grain, and seeds.
2287. Adolph Staadt, 3, Grande-place, Brussels—Improvements in obtaining motive-power when gravity and steam or expansive fluids are used. (Partly a communication.)

Dated 13th October, 1855.

2289. Hugh Greaves, New Palace-yard—Improvements in the construction of steam-boilers.
2291. John Durance, Barge-yard, Bucklersbury—Improvement in the frames of pianofortes.
2293. Louis Ullrich, Prague—Improvements in the means of indicating the number of persons entering an omnibus, or other carriage, any theatre, or other building.
2295. Thomas and William Hemsley, Melbourne, near Derby—Improvement in the manufacture of embossed and craped fabrics.
2297. Manuel Perez Lozano, Crutchedfriars—Improvements in treating pyrites and ores containing sulphur, in obtaining sulphuretted hydrogen, and in precipitating copper from solutions. (A communication.)
2299. John Stenhouse, 15, Upper Barnsbury-street, Islington—Improvements in the preparation of decolourising materials.

Dated 15th October, 1855.

2303. Samuel Kent, Liverpool—Improvements in purifying and measuring water, parts of which are applicable to measuring other fluids.
2305. James Miller Brown and Thomas Brown, 165, Piccadilly—Improvements in the manufacture of folding chairs.

Dated 16th October, 1855.

2307. Lewis Normandy, 67, Judd-street, Brunswick-square—Improvements in the mode of writing and printing music, to facilitate the study thereof. (A communication.)
2311. Edwin Wilkinson, Woodhouse, York—Improved mode of extracting grease from woollen, cotton, and worsted waste.
2313. William Edward Newton, 66, Chancery-lane—Improvements in the construction of fire-arms. (A communication.)
2315. James Fraser, Jermyn-street—Improvement in the manufacture of paper or paper pulp. (A communication.)

Dated 17th October, 1855.

2317. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of anchors.
2319. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of railway bars.
2320. William Thomson, Perth—Improvements in four-wheeled carriages.
2321. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of cast-steel.
2323. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in metal beams, girders, and tension bars, used in the construction of roofs, floors, and other parts of buildings, and in the construction of viaducts and suspension and other bridges.
2325. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of ordnance, and in the projectiles to be used therewith.
2327. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of railway wheels.
2329. John Talbot Pitman, 67, Gracechurch-street—Improvement in fire-arms. (A communication.)
2331. John Adcock, Marlborough-road, Dalston—Improved apparatus for measuring and indicating the distance travelled by ships or other vessels.

Dated 18th October, 1855.

2333. Charles Edwin Jones, Huddersfield—Improvements in machinery for raising water and other liquids by means of a combination of the principle of the accumulation of force, by compression of air or other elastic fluids, and that of centrifugal force, the more readily to obtain increased mechanical power thereby.
2335. William Glass, 2, Dahlia-cottages, Millwall, Poplar—Improvements in obtaining a deodorising and disinfecting material.
2337. Doctor Graham, Over Darwen—Improvements in the manufacture of paperhangings and in machinery to be used in such manufacture. (A communication.)
2339. John Cheesman Wagstaff, 20, Grosvenor-street—Improvements in the manufacture of seamless garments and other seamless fabrics. (Partly a communication.)

Dated 19th October, 1855.

2341. John Smith, 32, Brydges-street, Covent-garden—Improvements in the construction of bedsteads, such improvements being applicable to carriages, ambulances, and other articles.
2342. William Tatham, Rochdale—Improvements in machinery, or apparatus for preparing, spinning, doubling, and winding cotton, wool, flax, silk, or other fibrous substances.
2347. Henry Giller, Southampton-street—Improvements in globes and shades for gas and other lights.
2349. William Field and Edward Jeffreys, Shrewsbury—Improved means for securing the rails of railways in their chairs or bearings.

Dated 20th October, 1855.

2351. Pierre Arnaud Massip, 39, Rue de l'Echiquier, Paris—A machine for preparing hat linings. (A communication.)
2353. Nathaniel Shattswell Dodge, St. Paul's-churchyard.—Improvements in machinery or apparatus for spreading or distributing water-proofing or similar compositions over webs and sheets. (A communication.)
2355. Frederick Whitaker, Murray-street, New North-road—Improvements in the construction of sewing-machines.
2357. Henry Woodrow, Wood-street, Cheapside—Improvements in shirts.

Dated 22nd October, 1855.

2359. Alexander Parkes, Burry Port, Llanelly—Certain preparations of oils for, and solutions used when waterproofing, and for the manufacture of various articles by the use of such compounds.
2361. Charles Lenny, Croydon—Improvements in carriages.
2363. Vincent Scully and Bennett John Heywood, Dublin—Improvements in clips or holders for suspending railway-tickets and other small articles.

Dated 23rd October, 1855.

2365. William Wilson, Manchester—Improvements in machinery for crushing grain and other substances.
2367. Adolphus Oppenheimer, Manchester—Improvements in machinery or apparatus for stretching or distending velvets and other piled goods or fabrics for the purpose of cutting the pile of such goods.
2369. John Bellamy, Lower-road, Islington—Improvements in graining and in producing imitative ornamental surfaces, and in certain instruments or apparatus to be employed for such purposes.
2371. Thomas Richardson, Portland-place, Newcastle-on-Tyne—Improvements in the manufacture of glass and clay wares.
2373. Henry Weber, Zurich—Improvements in apparatus for motive-power.

Dated 25th October, 1855.

2377. Jacques Rives, 53, Boulevard St. Martin, Paris—Improvements in looms for weaving.
2379. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in lamps. (A communication.)
2381. John Edward Mayall, 226, Regent-street—Improvements in photography.
2383. Charles Crickmay, Lambeth, and Frederick Joseph Clowes, Camberwell—Improvements in the manufacture of guns, pistols, and gunstocks, and in cutting and carving wood, metals, and minerals, and other materials by machinery.
2385. Eugène Hippolyte Rascal, Catherine-street, Strand—Improvements in apparatus used in the manufacture of type and other articles for letter-press printing. (A communication.)
2387. Henry Tritton, Great Grimsby—An improved safety apparatus for the protection of persons while painting the exterior of buildings and cleaning windows, which may be used as a balcony for holding flowers.
2389. James Platt and John Whitehead, Oldham—Improvements in machinery or apparatus for preparing clay for the manufacture of bricks.
2391. John Andrew Richards, 10, Tyer's-gateway, Bermondsey-street—Improvements in producing the 'hard grain' on leather.

Dated 26th October, 1855.

2392. John Pinches, Oxendon-street, Haymarket—Improvements in the construction of dies or stamps for marking papers, linen, or other substances.
2395. Edwin Pugh, Charham, Kent—Safety alarum and signal apparatus.

Dated 27th October, 1855.

2397. Edward Stark, Monkton, Isle of Thanet—Improvements in pens for writing.
2398. Henry Wyatt, 58, Pall-mall—A peculiar apparatus for more rapidly and perfectly manœuvring or steering steam ships of war or of commerce, which is entitled 'The Transpulsor.'
2399. Simon O'Regan, Liverpool—Improvements in marine-engine boilers, and other boilers and their furnaces.
2401. John Ashton, Oldham—Improvements in certain parts of machinery known as 'self-actors' (employed for spinning and doubling cotton and other fibrous materials), for more effectually crossing the yarn during the shaping or building of the 'cops' than heretofore.
2403. Peter Cranke Wood, Guilford-street-east—Improved machinery for preparing or scutching flax, and other analogous fibrous substances. (A communication.)
2405. Edwin Tomlinson, Barns Cray, Crayford, and Alfred Mortimer Job, Islington—Improvements in water-proofing skins of animals.
2407. Alfred Able, Spring-street, Sussex-gardens, Hyde-park—Improvements in stopping, filling, or plugging teeth, and in instruments to be used therefor.

Dated 29th October, 1855.

2409. Thomas Ato Temperton, Manchester—Improvements in shells and rockets, and other projectiles of a like nature.
2411. John Kennard, 32, Little Queen-street, Holborn—Improvement in the manufacture of children's and invalids' carriages.
2413. Germain Jean Paul Marie Villeroux, Paris—Improvements in the manufacture of soap.
2415. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in regulating the transmission of motive-power. (A communication.)
2416. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in breaks for railway carriages. (A communication.)

Dated 30th October, 1855.

2417. Paul Emile Chappuis, 69, Fleet-street—Improvements in reflectors for the diffusion of artificial light.
2419. William Naylor, Norwich—Improvements in power hammers and rivetting machines.
2421. Thomas Hocroft, Tividale, and Richard Forrest, Tipton—Improvements in the manufacture of iron rods, bars, hoops, merchant, and guide iron.

Dated 31st October, 1855.

2423. William Henry Walenn, 46, Regent-street—Self-acting attachment to be applied to gates. (A communication.)
2424. Robert Griffiths, Lower Broughton, Manchester—A compound and exact measurement tap, applicable to the measurement of every kind of liquor or liquid.
2425. James Gray Lawrie, Glasgow—Improvements in ship-building to facilitate the use of water as ballast.
2426. Thomas Webster Rammell, Trafalgar-square—Improvements in preparing black lead, chalk, and other materials used for drawing, writing, and marking.
2427. Henry Edwin Drayson, Maresfield Powder Mills, Sussex—Improvement in the manufacture of gun-powder.
2428. George F. Woolston, Washington, U. S.—Improvements in cutting and planing wood.
2429. Thomas James Swinburne, South Shields—Improvements in furnaces or apparatus used in the manufacture of glass.
2430. Thomas Shipp Grimwade, Harrow—Improvements in treating milk in order to preserve it.
2431. Richard Pannell Forlong, Bristol—Improved manufacture of manure.
2432. Alfred Vincent Newton, 66, Chancery-lane—Improvements in the manufacture of gas. (A communication.)

Dated 1st November, 1855.

2433. James Leetch, Margaret-street—Improved method of constructing apparatus for the covering of the head.
2434. Henry Barber Beaumont, 11, Gloucester-terrace, Hyde-park—Improvements in portable dwellings or huts, vehicles, and boxes, or packing materials for travellers.
2435. Henry Laxton, 19, Arundel-street, Strand—Improvements in gearing for increasing or decreasing rotary speed. (A Communication.)
2436. Richard Reeves Cox, Fareham—Improvements in the manufacture of artificial fuel.
2437. George Milner, 13, Hollen-street, Wardour-street, St. Ann's, Westminster—Improvements in the manufacture of bedstead bottoms, part of which improvements are applicable to various other purposes for commercial and domestic use.
2438. David Louis Antoine Nicole, 16A, Chichester-place, King's-cross—Improvements in apparatus for winding up watches.
2439. William Taylor, Haughton, near Shiffnal—Improvements in the manufacture of iron.
2440. John Pinches, Oxendon-street, Haymarket—Improved machine or apparatus for embossing paper, metal, and other substances by hand.
2441. Joseph Bentham, Bradford—Improvements in looms for weaving.
2443. Robert Kerr, Glasgow—Improvements in spinning together fibrous materials of different kinds.
2444. Lewis Normandy, 67, Judd-street, Brunswick-square—Improvements in securing the rails in railways. (A communication.)
2445. William Henry Walenn, 46, Regent-street—Improvements in pianofortes. (A communication.)
2446. Edwin Thomas Truman, Old Burlington-street—Improvements in palates or holders for artificial teeth.

Dated 2nd November, 1855.

2447. Isham Baggs, Pentonville, and Henry Forfar Osman, 33, Essex-street, Strand—Improvements in steam-engines and in engines generally which are worked either by gas, air, or vapour, and in apparatus for generating electricity, for effecting parts of said improvements, and for other purposes.
2448. John Cottrill, Great Lever, near Bolton—Improvements in machinery or apparatus for washing, scouring, dyeing, sizing, and cleaning woven fabrics and yarns.
2449. Mark Osborne, Birmingham—Improvements in metallic bedsteads and other articles of metallic furniture.
2450. John Patterson, Beverley—Improvements in mills or machines for grinding, crushing, cutting, and hulling or shelling various kinds of farm produce, and also for crushing and grinding minerals and other substances.

2451. Robert Cook, Glasgow—Improvements in apparatus for effecting the operations of punching, riveting, and shearing.
2452. Werner Staufen, 9, Baker-street, Portman-square—A substitute for hair and other substances commonly employed for stuffing cushions, furniture, and other articles.
2453. Samuel Heseltine, Harwich—Improvements in the means of ascertaining the depth of water in rivers, harbours, and at sea.
2455. John Jones, St. Asaph—Improvement in electric telegraphs.

Dated 3rd November, 1855.

2456. James Smith Cottrill, Great Lever, near Bolton—Improvements in machinery or apparatus for washing, scouring, dyeing, sizing, and cleaning woven fabrics and yarns.
2457. James Heginbottom, Ovenden—Improvements in furnaces and apparatus for generating steam, whereby the smoke will be consumed and the fuel economised.
2458. James Eastwood, Mill House, Midgley, York—Certain machinery or apparatus for taking out the slubs, noils, and knots from worsted sliver, slubbing, and roving.
2459. James Pattison, Glasgow—Improvements in machinery for dressing and finishing woven goods and fabrics.
2460. George Davis, Southampton—Improvements in apparatus for letting in or shutting off water or other liquids.
2461. Thomas Robert Cooper, White Mill-cottage, Battersea-fields—Obtaining motion with power and velocity by purely mechanical means.
2462. William Robertson and James Henry, Edinburgh—Improvements in machinery for reaping and mowing corn or other agricultural produce.
2463. James Binning, Liverpool—Improvements applicable to embossing presses.
2464. James Greenshields, Glasgow—Improvements in the manufacture or production of drying oleaginous compounds.
2465. Thomas Ridgway Bridson, Bolton-le-Moors—Improvements in preparing, beetling, or finishing textile fabrics.
2666. William Gardner, Droylesden—Improved method of manufacturing watches or other timekeepers, and also improvements in the machinery, tools, or apparatus for accomplishing the same.
2467. William Prior Sharp and William Weild, Manchester—Improvements in the reeling or winding of cocoons, and in the manufacture of silk-threads, and in machinery and apparatus for these purposes. (Partly a communication.)
2468. Fennell Allman, Cambridge-terrace—Improvements in apparatus for the production of steam.
2469. George Lloyd, Birmingham—Improvements in illumination.
2470. George Collier, Halifax—Improvements in weaving carpets and other pile fabrics.
2471. Richard Archibald Brooman, 166, Fleet-street—Improvements in knitting machinery. (A communication.)
2472. Richard Archibald Brooman, 166, Fleet-street—Improvements in generating motive-power. (A communication.)

Dated 5th November, 1855.

2473. Robert Spring Garden, Piccadilly—Improvements in the manufacture of hats.
2474. John Hicks, Bedford-place, Clapham-rise—Improved gauge-valve, applicable to boilers of steam-engines, and to other purposes.
2475. Arthur Dobson, Belfast—Improvements in preparing certain unbleached linen fabrics.
2476. Francis Hawkes, sen., West-street, Reading—Improvements in the construction and arrangement of water-closet apparatus.
2477. James Nuttall, Silver-street — Improved gauntlet glove and cuffed glove
2478. Henry Clinton Page, 1, Commercial-road-south, Pimlico—Improved method of indurating marble and stone, and of permanently fixing colours therein, when colouring matters are applied thereto, for producing a variegated pattern or device on the surface thereof.
2480. Maurice Gillemot, Paris—Improvements in stopping horses.
2481. George Burridge, Great Portland-street—Improvements in the preparation of glass for ornamental purposes.
2482. Peter McGregor, Dumbarton — Improvements in water-closets.
2483. George Baring Locke, Notting-hill, Kensington—Apparatus, apparatuses, or mechanism for placing detonating or fog signals on the rails of railways to be exploded thereon, and for removing the same therefrom whenever required.
2484. Thomas Thomas, jun., Bristol—Improvements in the manufacture of soap.
2485. Alfred Vincent Newton, 66, Chancery-lane—Improved apparatus for cooling and drying flour. (A communication.)
2486. Alexander Charles Louis Devaux, King William-street, City—Improvements in the construction and the fitting up of granaries.
2487. Richard Archibald Brooman, 166, Fleet-street—Improvements in fire-arms. (A communication.)

Dated 6th November, 1855.

2488. Joseph Jessop, Lascelles Hall, near Huddersfield—Improvements in the construction of furnaces and boilers.
2489. Frederic Ludewig Hahn Danchell, 4, Arthur-terrace, Caledonian-road, Islington—Improvements in apparatus for ascertaining the pressure of steam, air, water, or any other fluid or liquid.
2490. Richard Goose, Birmingham—Improvements in the manufacture of cut nails.
2491. Joseph Schloss, Wellington-chambers, Cannon-street-west—A new mounting for travelling-bags.
2492. Richard Threlfall and John Higson, Preston—Improvements in machinery or apparatus used in preparing or sizing and dressing yarns for weaving.
2493. Samuel Cunliffe Lister, Manningham, near Bradford—Improvements in weaving pile fabrics.
2494. Anthony Dugdale, Rue Ponthieu, Paris—Improvements in the construction of locomotive engines, applicable in part to marine and stationary engines.
2495. Edward Jeffreys, Shrewsbury—Improvement in the construction of furnaces.

Dated 7th November, 1855.

2496. George Cotsell, Brompton—Improved gutter and kerb for roads and streets.
2497. Charles Hanson, Pimlico—Improvements in fire-arms.
2498. Charles Hart, Wantage—Improvements in threshing and dressing machines.
2499. Joseph Haley, Manchester — Improvements in the buffers and spring draw-bars of waggons or other railway vehicles, and in the application of the same.
2500. Frederick Scholefield, Manchester—Improvements in machinery or apparatus for cutting paper, card-board, and similar materials.
2501. William Grindley Craig, Gorton, near Manchester—Improvements in bearing, buffing, and draw-springs, applicable to the rolling stock of railways and other vehicles.
2502. William Kenworthy, Blackburn— Improvements in steam-engine valves, and in the mode of working the same.
2503. William Davis, Northampton-place, Old Kent-road—Improvements in the construction and arrangement of furnaces and furnace-bars for the better combustion of smoke and prevention of loss of heat by radiation.
2504. Louis Benoit Advielle, Paris—Improved process for silvering metallic articles.
2505. William Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture and application of prussiates and other colouring matters. (A communication.)
2506. John Wakefield, Inchicore Works, Dublin—Improvements in machinery for working the slides and steam-valves of engines driven by steam or other elastic fluid.
2507. William Dray, Swan-lane—Improvements in apparatus for heating, baking, and drying.
2508. Charles Marie Pouillet, Paris — Improvements in railways.
2509. William Lund, Fleet-street, and Alexander Bain, Paddington—Improvements in pencil-cases.
2510. Thomas Godding, Ipswich — Improvements in the fastening for stays, corsets, and bands.
2511. Charles Allen Browne, Massachusetts, U.S.—A machine for manufacturing bricks. (A communication.)
2512. Henry John Betjemann, New Oxford-street—Improvements in expanding or extending tables. (Partly a communication.)
2513. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in wrought-iron shafts for steam-boats and other purposes where a great strength is required. (A communication.)
2514. Charles William Siemens, Adelphi—Improvements in evaporating brine and other liquids, and in distillation.
2515. Thomas Burgin, Great Winchester-street—Improved construction of ledger hand-rest.

Dated 8th November, 1855.

2517. Charles Page, Ware—Improved construction of railway signal apparatus.
2518. Louis Gasté, 58, Paradis Poissonnière, Paris—Improvements in binding account and other books.

Dated 9th November, 1855.

2521. John Raywood, Wentworth, Yorkshire — Improved rolling, dribbling, sowing, and harrowing machine for wheat and other agricultural produce.
2522. George Barry Goodman and George Alfred Webster, 21, York-buildings—Improvements in apparatus for reflecting the back, front, and sides of the figure and head in a mirror or toilette glass at one view.
2523. Henry Fletcher, Manchester—Improvements in the manufacture of nuts, bolts, and other similar articles, and in machinery or apparatus for making the same.
2524. James Bramwell, Royal Exchange-buildings, and John Crawford, Newcastle-upon-Tyne—Improvements in ordnance.
2525. William Henry Walenn, 46, Regent-street—Improvements in looms for weaving seamless bags and other open double fabrics of a similar character. (A communication.)
2526. Charles Joseph Hampton, Llynrivale, Llangynwyd, Glamorgan—Improvements in the manufacture of iron.
2527. Thomas Pritchard, Walsall—Improvements in manufacturing welded iron tubes.

Dated 10th November, 1855.

2528. William Peter Piggott, 523, Oxford-street—Improvements in galvanic, electric, and electro-magnetic apparatus, and in the mode of applying the same as a curative and remedial agent.
2529. William Henry Bentley, Bedford—Improved cannon, guns, and other fire-arms, and appendages thereto, and in the capsules, cartridges, and projectiles for the same and other fire-arms.
2530. Joseph Scott, Glasgow—Improvements in corking bottles, jars, and other receptacles.
2531. Louis Eskell, 22, Cockspur-street, Pall-mall—A new enamel for filling or stopping decayed teeth.
2532. Alfred Vincent Newton, 66, Chancery-lane—Improvements in transmitting fac-simile copies of writings and drawings by means of electric currents. (A communication.)
2534. Henry Wickens, 4, Tokenhouse-yard, Bank—Improvements in locomotive steam engines, and in apparatus in connexion therewith, parts of which improvements are respectively applicable to other steam engines and purposes.

Dated 12th November, 1855.

2535. William Crosley, 16, Westbourne-park — Improvements in gas meters.
2536. Jules Cesar Alexander Bouillotte, Paris—Improved letter copying press.
2537. Louis Joseph Frédéric Margueritte, Paris—Improvements in the manufacture of vitreous products.
2538. William Kemble Hall, 36, Cannon-street—The prevention of steam boiler explosions.
2539. William Kemble Hall, 36, Cannon-street—Improvements in boilers for generating steam. (A communication.)
2540. George Cooke, Kersley, Lancaster—Improvements in flyers used in roving and slubbing frames.
2541. Thomas Hitt, Tavistock-street—A new method of obtaining power for propelling vessels, and certain new propelling machinery.
2542. John Yull Borland, Manchester—Improvements in spinning, and machinery for preparing and spinning fibrous materials.
2543. William Henry Aston and Samuel Hopkinson, Zetland Mill, Huddersfield—Improvements in steam-boiler furnaces and apparatus employed for supplying water to steam-boilers.
2544. Joshua Kidd, 75, Newgate-street—Improvements in machinery and apparatus for sewing or stitching and ornamenting cloth or other fabrics.
2545. Andrew Barclay, Kilmarnock—Improvements in indicating the pressure of steam and other fluids, which improvements are also applicable to governors and other regulating apparatus.
2546. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in casting metals. (A communication.)
2547. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture or preparation of hard india-rubber, and in the application thereof to the construction of parts of textile and other machinery. (A communication.)
2548. William Carr Thornton, and Benjamin Thornton, Cleckheaton — Improvements in machinery or apparatus for preparing and spinning wool, which improvements are also applicable to washing and wringing machines for the same material
2549. William Henson, Bryan-street, Caledonian-road, and Henry Oscar Palmer, Castle-street, East-street, Marylebone — Improved apparatus for propelling vessels.

Dated 13th November, 1855.

2551. Fischer Alexander Wilson, Adelphi-chambers—Improvements in engines, machinery, and apparatus for exhausting, forcing, and lifting, for propelling on land and water.
2552. Julius Homan, Milk-street, Cheapside—Improvements in machinery for cutting up woven and other fabrics.
2553. John Wilkinson, sen., and John Wilkinson, jun., Leeds—Improvements in communicating a shape or configuration to felted cloths and other manufactured fabrics.
2554. William Webb and John Webb, junior, and James Catstree, Birmingham—Improvements in attaching door knobs to spindles.
2555. John Mawson, Newcastle-upon-Tyne—Improvements in cameras for taking photographic pictures.
2556. Frederick Abraham Eskell, Manchester—Improvements in plates for attaching artificial teeth.
2557. Robert Murdoch, Cran-hill, Glasgow — Improvements in agricultural apparatus for sowing seeds and depositing manure.
2558. William Foster, Black Dike-mills, near Bradford—Improvements in machinery or apparatus for drying wool and other fibrous materials.

Dated 14th November, 1855.

2559. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improvements in producing ice. (A communication.)
2560. Henry Laxton, 19, Arundel-street, Strand—Improvements in fire-arms. (A communication.)
2561. James Burrows, Haigh Foundry, near Wigan—Improved apparatus for winding coals or other minerals from mines, which said apparatus is also applicable for other similar purposes, and for machinery required for forming or constructing such improved apparatus.

2562. Thomas Skinner, Sheffield—Improvements in producing figures or ornaments npon the surfaces of metals.
2563. William Barnes, 2, Royal Exchange-buildings—Improvement in connecting and supporting the ends of the rails of railways.
2564. Cyprien Marie Tessie du Motay, Paris—Improvements in the manufacture of lubricating materials.
2565. Joseph Robinson, Denton Mills, Carlisle—Improvements in machinery for drying wheat and other grain.
2566. Cyprien Marie Tessié du Motay, Paris—Improvements in the treatment of fatty and oily matters.
2567. Charles Goodyear, 42, Avenue Gabrielle, Paris — Improvements in shoes and boots when india-rubber is used.
2568. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improved safety coal-hole cover. (A communication.)
2569. Frank Jacques, Droylsden—The use and method of preparation of a new material to be used in the process of dyeing silk.
2570. Edmond Godefroid Cox, Lille—Improvements in picking or cleaning cotton, wool, and other filamentous substances.
2571. Alfred Vincent Newton, 66, Chancery-lane—Improved manufacture of electrotype printing surfaces. (A communication.)
2573. Johannes Moler, 3, Maynard-place, Hornsey — Producing a transparent photographic picture on ivory, without injuring the nature of the ivory, so as to be able to finish the picture with colours like other minatures.

Dated 15th November, 1855.

2574. John Talbot Pitman, 67, Gracechurch-street—Improvements in the construction of iron beams and girders, and in machinery for making the same. (A communication.)
2575. Franz Duncker, Berlin—A new instrument for electric telegraphs called "Despatch Distributor," which will permit despatches of various contents being communicated at the same time to one or more stations by means of one or two line wires only. (A communication.)
2576. Joseph Lester Hinks, Birmingham—Improvements in brushes.
2578. William Lea, Wolverhampton—Improvements in taps or cocks.
2579. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in carding engines for carding cotton and other fibrous materials. (A communication.)
2580. Duncan Morrison, Bordesley Works, Birmingham—Improvements in the manufacture of articles with internal screws, when cast iron, malleable cast iron, or cast brass is employed.
2581. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in breech-loading fire-arms. (A communication.)

Dated 16th November, 1855.

2582. Charles Crum and Charles Paul, Hudson, Columbia, New York—Process for making bread.
2583. Benjamin Talbott Babbitt, New York—Manufacturing soap.
2585. William Eassie, Gloucester—Improvements in hammers.
2586. Thomas Hudson, Warrington — Improvements in machinery or apparatus for cutting and punching metals, paper, leather, and similar articles.
2587. James Yates and Thomas Rawlins Birch, Birmingham—Improvements in engines for raising beer and other liquids.
2588. James Hinks and Frederick Dowler, Birmingham—Improved machinery for the manufacture of percussion caps, and for cutting out and raising articles in metal generally.
2589. Edward Peyton and Duncan Morrison, Bordesley Works, Birmingham—Improvements in manufacturing parts of metal bedsteads.
2591. Louis Auguste Petard, Paris—Improvements in manufacturing velvet and other similar fabrics.

Dated 17th November, 1855.

2592. John Hosking, Gateshead Iron Works—Improvements in vertical direct-action marine-engines.
2593. Joseph Denton, Pendleton, near Manchester—Improvements in looms.
2594. Henry Ball, Great Russell-street, Birmingham—Improvement in gun-sights.
2595. Robert Walter Swinburne, South Shields—Improvements in furnaces used in the manufacture of glass.
2597. George Collier, Halifax, and James William Crossley, Brighouse—Improvements in means or apparatus employed in hot pressing woven fabrics, and other surfaces.
2598. George Collier, Halifax, and James William Crossley, Brighouse—Improvements in finishing fabrics and in treating yarns, part of which improvements is also applicable to producing ornamental effects upon other surfaces.

Dated 19th November, 1855.

2600. John Fleetwood, Elm Grove House, Southsea—Improved portable apparatus for making malt, and for drying hops, corn, and other grains and seeds.
2602. William Smith, 10, Salisbury-street, Adelphi—Improvements in gas regulators. (A communication.)
2604. Richard Archibald Brooman, 166, Fleet-street—Improvements in apparatus for measuring liquids, which may also be employed as a motive-power engine. (A communication.)
2606. Jeanne Barbe Ve. Lopez, 57, Rue de Bretagne, Paris—An antibilious powder.
2608. William Henry Preece, 7, Bernard-street, Primrose-hill—Improvements in electric telegraphs.

Dated 20th November, 1855.

2610. John Poole, 2, Ryley-street, Chelsea—Improved mode of regulating the supply of steam from the boiler to the cylinder, and thereby better governing the motion or speed of steam-engines.
2612. Alfred Vincent Newton, 66, Chancery-lane—Improved apparatus for dressing flour. (A communication.)
2614. William Harvey, Mansfield—An apparatus to be employed with reels, cylinders, or rollers, and for placing upon or taking off therefrom hanks, skeins, bands, and other articles without removing such reels, cylinders, or rollers from their bearings.
2616. Charles Frederick Clark, Wolverhampton—Improvements in bolts and fastenings, which they propose calling Clark and Co.'s Longitudinal Wedge-bolt.
2618. David Simpson Price, 2, South Molton-street, and Edward Chambers Nicholson, 3, Newington-crescent—Improvements in the manufacture of cast iron.
2620. Oliver Maggs, Bourton Foundry, Dorset—Improvements in machinery for threshing and winnowing wheat and other grain.
2622. Coleman Defries, Houndsditch—Improvements in the roof lamps for railway carriages.

Dated 21st November, 1855.

2626. Peter Armand le Comte de Fontaine Moreau—4, South street, Finsbury—Improvements in treating fatty acids. (A communication.)
2628. Henry William Wimshurst, St. John's-wood—Improved machinery for cutting dovetails and tenons.

Dated 22nd November, 1855.

2630. Alexander Tolhausen, 7, Duke-street, Adelphi—Improvements in bombs and other explosive projectiles whose charges are to be fired by percussion. (A communication.)
2632. George Price, Cleveland Safe Works, Wolverhampton—A box, chest, or case, for the preservation of parchment deeds and documents from damage by steam, when placed inside an iron safe made fireproof on the vapourising principle.
2634. Henry Hibling, Norwich—Improvements in waterproof boots and shoes.
2638. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in apparatus for making aërated beverages. (A communication.)

Dated 23rd November, 1855.

2640. Thomas Tuckey, Cork—Modes of construction, by which steam or other vapour or gas may be used as a source of motive power for some purposes more conveniently than hitherto, and more suitably for locomotion on common roads.
2642. John Pursloe Fisher, Edgbaston, near Birmingham—Improvements in the construction of the hammers of pianofortes.
2644. Joseph Ellisdon, Liverpool—Improvements in 'castors' for cabinet-furniture.
2646. Samuel Cunliffe Lister, Bradford, and James Warburton, Addingham—Improvements in spinning.

Dated 24th November, 1855.

2648. Samuel Ratcliffe Carrington, Stockport—Improvements in the manufacture of hats.
2650. John Jephson Rowley, Rowthorne, near Chesterfield—Improvements in machinery for cleaning and cutting turnips and other roots.
2652. Juliana Martin, Soho-square—Improved self-acting incubator.
2654. Hiram Hyde, Truro, Nova Scotia—Improvements in the manufacture of mineral oils. (A communication.)

Dated 26th November, 1855.

2658. Enoch Harrison and Hilton Greaves, Manchester—Improvements in the manufacture of woven fabrics.
2660. Thomas Greenwood, Leeds—Improvement in the construction of carding engines.
2662. George Edward Dering, Lockleys, Hertford—Improvements in galvanic batteries.
2664. James Clark, 25, Billiter-street—Improvements in the chain-wheels used on capstans, windlasses, and other axes.

Dated 27th November, 1855.

2666. Thomas Allan, Adelphi-terrace—Improvements in applying electricity.
2668. Hiram Hyde, Truro, Nova Scotia—Improved manufacture of lubricating compound. (A communication.)
2670. Enoch Tayler, 62, Baldwin's-gardens, Gray's-inn-lane—Improvements in paddle wheels for propelling vessels in water.
2674. Samuel Amos Kirby, Hastings-street, Leicester.—Improvements in open stoves and grates for rooms and apartments.
2676. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in sheathing ships. (A communication.)
2678. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in cleaning and hulling grain and seeds, and in the machinery or apparatus employed therein. (A communication.)
2680. Thomas Warren, Glasgow—Improvements in the manufacture and moulding or shaping of glass.

Dated 28th November, 1855.

2682. Charles Herbert Holt, Manchester—Improvements in steam boilers, furnaces for the same, and apparatus connected therewith.
2684. George Richardson, Craig's-court, Charing-cross—Improvements in buffer, draw, and bearing springs for railway carriages and waggons. (A communication.)
2686. Joseph Lee, Stonall, near Walsall—Improvements in agricultural or farmers' engines, which improvements are applicable also to locomotive engines.
2688. William Alfred Distin, 31, Cranbourne-street, Leicester-square—Improvements in cornets and other wind musical instruments.

Dated 29th November, 1855.

2692. Arthur William Forde, 45, Bernard-street, Russell-square—Registering the number of revolutions of a wheel of a locomotive engine, or railway or other carriage, at any given period.
2694. William Irlam, Gibraltar Iron Works, Newton Heath, Manchester—Improvements in crossings for railways.

Dated 30th November, 1855.

2700. John Ramsbottom, Accrington, and John Charles Dickinson, Blackburn—Improvements in machinery or apparatus for measuring and registering water and other fluids, and obtaining motive-power from the same.
2702. Edward Daniel Johnson, Wilmington-square — Improvement in the construction of attachable seconds watches.
2704. Richard Hancock, Great Polgooth Mine, St. Austell—Cleaning and separating ores of every description when brought into a state of low pulverisation.
2706. Samuel Cunliffe Lister, Bradford—Improvements in treating so as to re-work waste yarns of cotton, silk, flax, wool, or other fibre.

Dated 1st December, 1855.

2708. William Ward, Warrington—Improvements in looms for weaving.
2712. James Murdoch Napier, York-road, Lambeth—Improvement in drying small coal.

Dated 3rd December, 1855.

2714. George Harrison, Burnley, and William Mitchell, jun., Hoarstone-lodge, near Burnley—Improvements in machinery for roving, spinning, and winding worsted, cotton, and other fibrous materials.
2716. Christian Mayer, New York—Improvements in hair-trigger-locks for fire-arms.
2718. Westley Richards and Joseph Rock Cooper, Birmingham—Improvement or improvements in breech-loading fire-arms.
2720. Jules Roth, Mulhouse, France—Improvement in rollers employed in spinning machinery, and in other parts of machinery used in the treatment of fibrous materials.
2722. James Leitch, Ellenborough-street, Liverpool — Improvements in melting and blowing up sugars.

Dated 6th December, 1855.

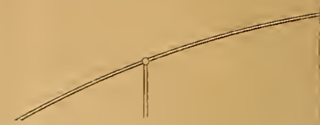
2742. Charles Hawker Fishbourne, Isle of Wight, and Thomas Parry Hawker, War Prison, Plymouth—Improved method of manufacturing cartridges.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2519. Cullen Whipple, U.S.—Improvements in machinery for preparing and combing fibrous materials.—8th November, 1855.
2533. Ephraim Green and Jacob Green, West Bromwich—Improvements in malt crushers.—10th Nov., 1855.
2623. Alexandre Tolhausen, 7, Duke-street, Adelphi—Making metallic chains. (A communication.)—21st Nov., 1855.
2747. Ebenezer Poulson, 21, Judd-street, Brunswick-square—A new constructed engine to be worked either by steam or principally by manual labour.—6th December, 1855.
2792. Jacques Elidat de Malbec, Paris—Improvements in water-closets.—11th December, 1855.

DESIGNS FOR ARTICLES OF UTILITY.

1855.
Nov. 22, 3786. Key and Co., Charing-cross, "Solocornn."
" 26, 3787. James Jones and Son, Bow-street, Covent-garden, "Gas Torch."
" 27, 3788. Francis Jackson, Derby, "Perpetual Office Almanack."
" " 3789. Arthur James Melhuish, Blackheath, "Part of a Photographic Camera."
" 28, 3790. Turner and Pegg, Leicester, "Clasp Fastening."
Dec. 5, 3791. Gideon Gledhill, Lindley, near Huddersfield, "Wind Guard and Ventilator."
" 6, 3792. George Grout, Tottenham, "The Crochet Cotton Armlet."
" " 3793. Richard Day Charles, Bristol, "Pair of Trousers."
10, 3794. Daniel William and Thomas Bentley, Margate, "A Steamer for Potatoes."
Dec. 12. 3795. G. A. Chambers, 13, Holywell-row, Finsbury, "Perambulator."
" 15. 3796. E. Israel, 15, Bury-street, "Flower-pot."
" 17. 3797. Grant, Brothers, Clement's-court, "The Volkoumen shirt."



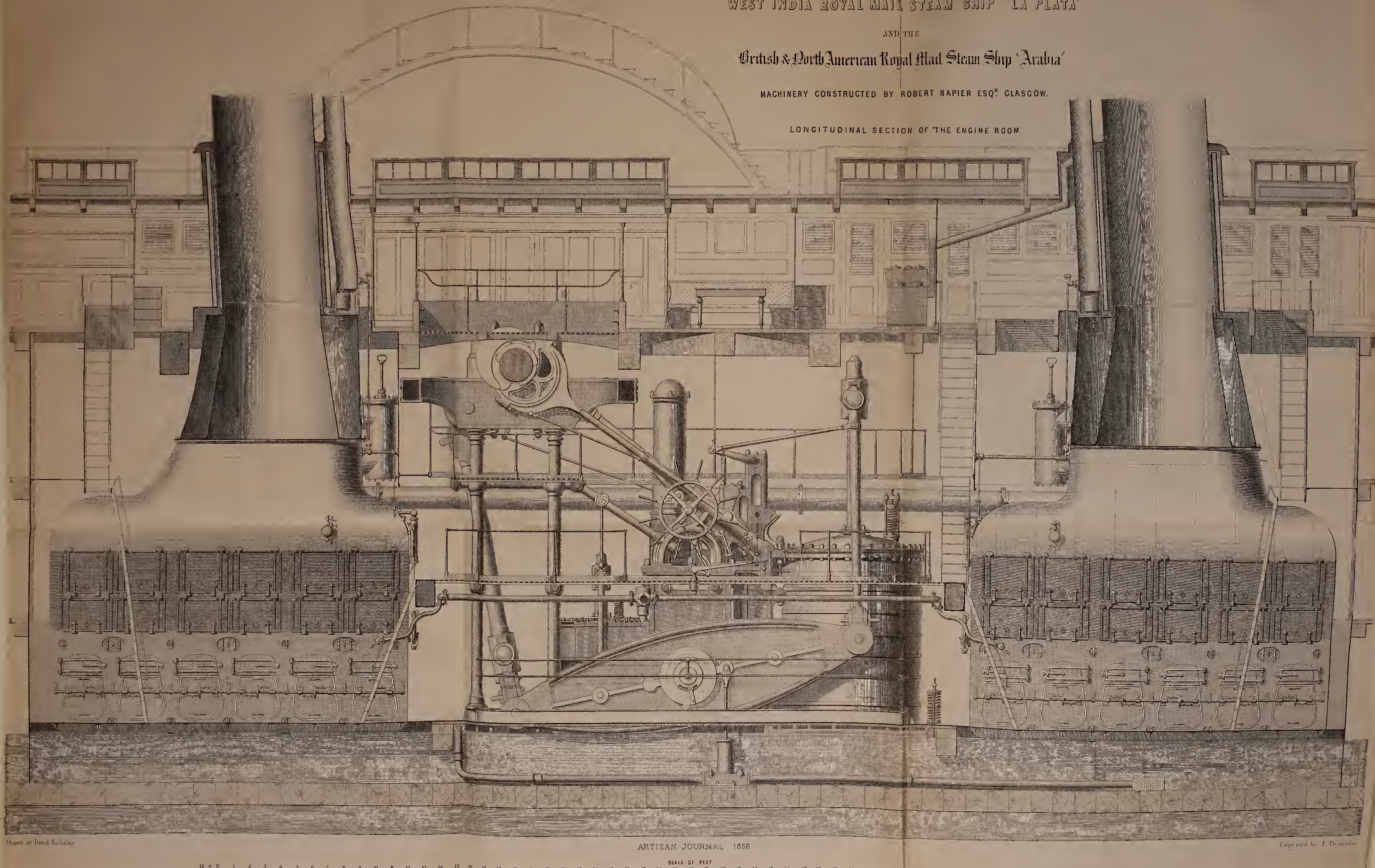
WEST INDIA ROYAL MAIL STEAM SHIP "LA PLATA"

AND THE

British & North American Royal Mail Steam Ship 'Arabia'

MACHINERY CONSTRUCTED BY ROBERT NAPIER ESQ^R. GLASGOW.

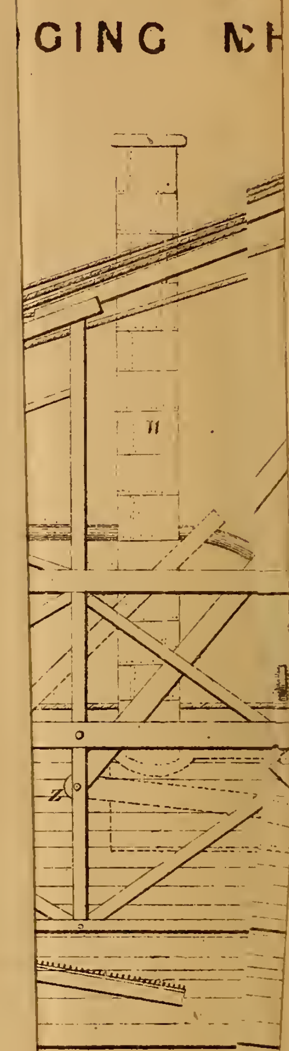
LONGITUDINAL SECTION OF THE ENGINE ROOM



Drawn by David Kirkaldy

Engraved by J. Pearson

SCALE OF FEET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// THE ARTIZAN.

No. CLVII.—Vol. XIV.—FEBRUARY 1st, 1856.

THE ARTIZAN.

COMPARATIVE RESULTS OBTAINED FROM THE SCREW AND PADDLE-WHEEL.

PERFORMANCE OF HER MAJESTY'S SCREW STEAMER "HIMALAYA."

Since the publication of the first part of this paper we have received several letters from correspondents on the subject of the *Himalaya's* screw, in answer to which we may state that the present one is the second screw with which she has been fitted, that the two are identical in size, pitch, &c., which were given in former papers, and they are both two-bladed; their weight, when bored, is 10 tons 4 cwt.—material, the best Welsh pig, with a little No. 1 Scotch. Helical surface of driving part of blades, 116 sq. ft. The first screw had a piece broken off one blade by striking some floating body at sea in the summer of 1855, and the new screw was fitted in consequence.

A spare screw with three blades, of same pitch and diameter as those of two blades named, but having a length of one-ninth of its pitch (and consequently the same surface as the others) has been made for her, and is now in store in Portsmouth dockyard.

The comparative performances of steam-vessels are usually estimated by engineers with reference to their co-efficients of immersed midship section and displacement. Some eminent men, when calculating the *probable* speed of a vessel not already tried, place a greater value on the co-efficient of immersed midship section than on that of displacement, contending that, in similarly formed vessels, the resistance will vary more in the proportion of square feet of section immersed than in number of tons of water displaced, and illustrate this reasoning by reference to results from vessels which have been lengthened considerably amidships, to make them more burthensome, and so retained their form of bow and stern; and which, when immersed to the same draught of water as in trial before alteration, have obtained, with the same power, an almost identical speed.

In such cases, the co-efficient of immersed midship section would, of course, remain the same; whilst those from displacement would vary in the proportion of the additional displacement obtained by the increased length. We admit this to be a powerful illustration of the value of this co-efficient, and fully agree in the opinion of its importance as an element in calculating the result of a vessel's performance; but we must not forget that the question among commercial men is "What will the ship carry, &c., with a certain power, and at what speed?" and the only plan by which we can answer this question approximately is by working out the co-efficients of displacement of vessels, and accumulating a fund of information for future guidance.

In our last Number we instituted a comparison of the relative performance of the *Himalaya* with a large paddle-steamer, the *Atrato*, and pointed out the great disproportion of power required to produce the same speed (nearly) in the two vessels; we will now compare the performance of the *Himalaya* with other screw-vessels, and will select from Mr. Atherton's interesting letter to The Artizan of April, 1855, and from other sources, the results from the screw steamers *Candia* and *Rattler*.

Date of Trial	*Candia.* August, 1854.	*Rattler.* June, 1844.	*Himalaya.* Janry., 1854.
Draught of water, mean	18 ft. 4 in.	11 ft. 3 in.	16 ft. 9 in.
Coal on board	550 tons.	——	700 tons.
Speed in knots per hour, mean	12 knots.	10 knots.	13·78 knots.
Immersed midship section	532 sq. ft.	274 sq. ft.	560 sq. ft.
Displacement in tons	2,520 tons.	870 tons.	3,220 tons.
Gross indicated H.P., mean	1,356 H.P.	428 H.P.	2,050 H.P.
Co-efficient of immersed midship section	678	654	716
Co-efficient of displacement	236	217	279
Revolutions of screw per minute	66	104	59
Diameter of screw	15 ft. 6 in.	10 ft. 0 in.	18 ft. 0 in.
Pitch of screw	20 ft. 0 in.	11 ft. 0 in.	28 ft. 0 in.
Area of screw immersed, viewed as a disc	188 sq. ft.	78·5 sq. ft.	250 sq. ft.
Proportion of do. to immersed midship section	$\frac{1}{2\cdot83}$	$\frac{1}{3\cdot49}$	$\frac{1}{2\cdot24}$
Slip of screw per cent.	$8\frac{1}{2}$	10·7	15
Multiple of gear	2 to 1	4 to 1	Direct.
Proportion of diameter to pitch	$\frac{1}{1\cdot29}$	$\frac{1}{1\cdot10}$	$\frac{1}{1\cdot55}$

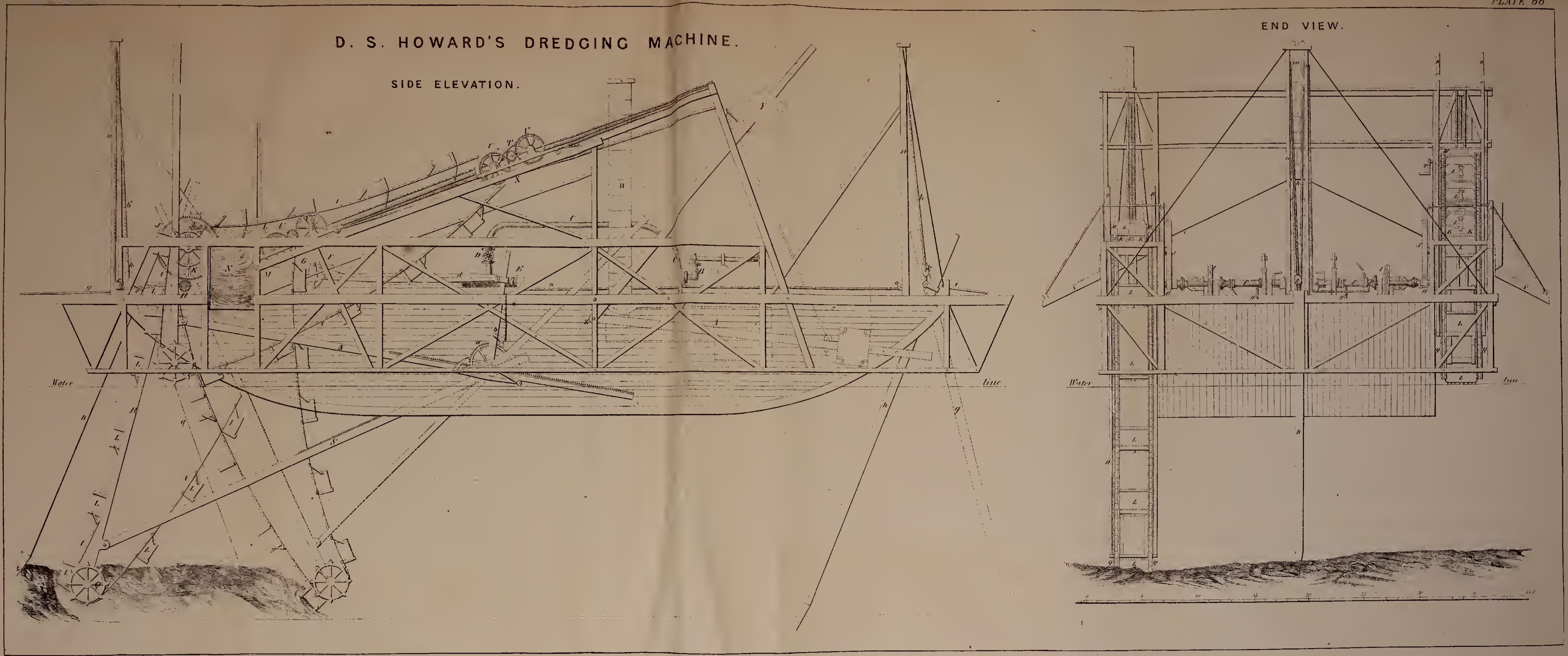
From the foregoing table of results at measured mile, we find that the co-efficients of immersed midship section and displacement from *Himalaya* are higher than those from *Candia* and *Rattler*, a result which might have been anticipated from her large size; and we believe also that they are the highest that have been obtained from *any vessel*, certainly of any published results.

Another fact worthy of observation also is, that the superior result has been obtained through the medium of what used to be considered a *coarse pitch*, viz., a pitch of about one-and-a-half times the diameter; the prevailing opinion a few years ago being that the pitch and diameter should be about the same, as in the case of the *Rattler;* but the increased experience of the last year or two has tended greatly to the employment of coarse pitch-screws, and we have known excellent results from screws with their pitch double and even rather more than double their diameter. The question of the relative proportions of screws, their pitch, diameter, and length or surface must, however, form the subject of another article.

The screw of the *Himalaya* had an advantage over those of the *Candia* and *Rattler* in comparative size, or area, viewed as a disc to immersed midship section, its proportion exceeding that of *Candia's* by 20 per cent. and the *Rattler's* by 35 per cent.; and there can be no doubt that the larger the column of water acted upon by the screw, compared with the vessel it urges onwards, the greater will be its efficiency.

This opinion appears to be gaining ground amongst our Government engineers, as we see that the *Marlborough* will have a screw 19 ft. diameter—those of the *Wellington, Agamemnon,* and *St. Jean d'Acre* being 18 ft.

D. S. HOWARD'S DREDGING MACHINE.



W. SMITH, C. E. DIREX.

The slip of *Himalaya's* screw, it will be observed, was greater than either *Candia's* or *Rattler's;* and, as a general rule, it will be found that an increased pitch relatively to diameter increases the slip, but we must not conclude from this that coarse pitch-screws are less efficient as propellers ; and in our next Number we will endeavour to show good reasons for assuming that this is not the case, that the slip of screws is so much influenced by the form of the after body of the vessel, by the state of weather at time of trial, &c. &c. ; moreover, it is so constantly varying under different circumstances, that it cannot be considered as a test of the efficiency of the propeller.

As our readers are aware THE ARTIZAN has always advocated direct-acting screw-engines, we have much pleasure in publishing these very good results obtained on so large a scale by this description of machinery; at the same time we do not, by any means, wish to detract from the merits of the *Candia*, whose engines we have engraved, and which are first-rate specimens of the most improved form of the geared-engine, but we are disposed to think that spur-wheels and pinions have no business in steam-vessels, and but a few more years will see the last of the genus.

ON THE SUPPLY OF WATER TO TOWNS AND CITIES.

IN this country, where so much is done by means of joint-stock companies and their associated capital, we are apt to overlook some of the evils which arise from monopolies. Railway, gas, and water companies, all exercise a practical monopoly ; and although they can never be said to be entirely free from the wholesome dread of competition, yet the probability of this is generally so far distant as to be disregarded. The French have always viewed monopolies with great distrust, and it might not be entirely out of place, even in this country, to exercise a little more control over them than the Legislature has yet thought proper to insist upon. The broad principle to be guarded against is the tariff of the monopolist, or the price at which he sells the article he deals in, whether it be a simple manufacture, or whether it be gas, water, or railway accommodation; the case which follows places in a broad and extreme light the general principal which M. Dupuit,* in the following pages, exemplifies in the particular instance of water companies.

Suppose any joint-stock company, possessing a practical monopoly, has tried a low tariff which produces them a net income of £10,000 a year. Then suppose they take it into their heads to try a tariff three times as high, and that this produces to them an income of only £1 more, or, say, £10,001. It is obviously the interest of the company to continue the high tariff, although it only benefits them in a degree infinitesimally small, while it inflicts a serious pecuniary loss and injury on the public. In the case here put, say one-third as many people deal with the company at the high tariff as would have been customers at the low one, and this one-third has to pay three times as much for the article, whatever it be. In other words, the public is debited to the extent of many thousand pounds, in order to put a few shillings extra into the pockets of the company. Of course this is an extreme case ; it is intended to represent such a case ; but it is impossible to deny that some such state of things prevails, to the great injury of the public, in all cases of monopoly.

If we now suppose this monopoly to be in the hands of a representative government, or of any public body, elected by popular suffrage, to represent the public interests, we cannot conceive such a state of things as the public being imposed upon by an exorbitantly high tariff for the sake of an infinitesimally small addition to the profits of the concern. It is obvious we should have a wiser and more equitable balance of interests, and from this consideration is derived the most powerful argument that can be advanced for placing both gas-works and water-works in the hands of corporations and under municipal control. In many cases, no doubt, great abuses have arisen from the transfer of these works out of the hands of public companies into those of corporations ; but this is an evil to be naturally expected from all sudden changes. The system, to be fairly tested, should be allowed several years to get properly into working order, and then it is probable that a very different result would appear. Judicious and economical management by a corporation, divested as much as possible of all party and political influence, can scarcely fail to prove advantageous to the community whom they supply with water, and we shall find, under such circumstances, that an inoppressive and moderate tariff of prices will be fixed on.

The example which M. Dupuit quotes with reference to the city of Toulouse, may also be considered an extreme case, and one scarcely applicable to English towns. He shows that, in Toulouse, a vast quantity of water is wasted simply because it is not offered for sale at a lower price. We are not aware that anything so gross and wicked takes place in English towns, because the companies take care to bring to the town no more water than they can sell.

The case which M. Dupuit puts would be analagous to that of the New River Company fixing an exorbitantly high tariff, thereby losing one-half their customers, but still realising the same income as at present, and pouring into the sewers the remaining half of their water, which they would fail to sell in consequence of the high price.

In addition to this, the Acts of most water companies impose a limit or maximum price, which the company cannot exceed, and this precaution has, no doubt, been found necessary in the progress of our parliamentary legislation. This maximum price serves to protect the public more effectually than the bug-bear of competition.

The following is a translation of a chapter bearing on this subject, and also comparing the advantages of constant and intermittent supply, from an able work lately published in France, by M. Dupuit, engineer-in-chief of bridges and highways, and director of the municipal service of the city of Paris :—

ON THE MODE OF DISTRIBUTING WATER TO PRIVATE CONSUMERS, AND THE PRICES CHARGED FOR WATER SUPPLY.

There are two methods of distributing water—one, called intermittent supply, and the other the constant supply. We shall say only a few words on the first method, for, although much used in England, it is condemned by all competent persons. In the intermittent system, private consumers receive their water during a certain time only—one hour in the day, for example ; the water is turned on from the street by a servant of the company, called the turncock ; all the cisterns are then filled, and this quantity must serve the consumer the remainder of the day. As it is impossible to calculate the capacity of the different cisterns in each house, or the very variable consumption of water, a waste-pipe is attached to all cisterns to prevent the overflow, and by this means much water is wasted. Whether the water is used, or otherwise, in any particular cistern, the supply is the same every day. This inconvenience might be remedied by ball-cocks, which shut the supply-valve when the cisterns are full. Such ball-cocks are used in large establishments in Paris, where the water is measured. But these ball-cocks would be expensive both to buy and to keep in order ; besides, the consumer is more interested in getting fresh water than in economising that of the company, which accounts for ball-cocks not being generally used. The loss of water resulting from this mode of distribution is enormous ; in London it is computed at half the entire quantity. Another inconvenience of this system is the necessity for placing cisterns in an elevated part of every house. This is troublesome and expensive, and yet is absolutely necessary when a high supply is required under the intermittent system. To prevent the water escaping, these cisterns are lined with lead. It is now quite certain that water thus preserved in open cisterns becomes, by the decomposition of the metal, a very active poison. The family of Louis Phillippe suffered much from this cause in England. To turn the water on and off from every house separately would require a great number of turncocks. To remedy this, service mains are laid down by the side of the principal main, and a valve being placed at the top of the different streets, the water is turned into

* "Traité Théorique et Pratique de la Conduite et de la Distribution des Eaux." Par J. Dupuit, Enginier en chef des Ponts et Chaussées, Directeur du Service Municipal de la Ville de Paris.—Paris, 1854.

the service-pipe, so that a whole street, or a portion of one, receives water at the same time. In case of fire, the consumer can use only the insignificant quantity of water in his cistern; he must send for the turncock to put on the water, and often, before this is done, the house is burnt down.

Mr. W. Baddeley, engineer and inspector of several fire insurance companies, affirms that out of 838 fires, which occasioned serious disasters in London in 1849, two-thirds might have been extinguished by the system of constant pressure. We will insist no more on the mode of intermittent supply; what we have said sufficiently shows its inconveniences; and it is quite certain we cannot now recommend this mode of distribution. In the constant supply all the pipes terminate directly or indirectly in a public reservoir, and, whenever the valve is opened, the water flows in proportion to the head in the reservoir. Cisterns are also unnecessary, except for consumers who wish to use more than the produce of their tap; but this cannot happen except in large manufacturing establishments, for the proprietors of which a cistern is not a sensible expense.

The system of constant supply once admitted, the question arises ought the water to be measured? We unhesitatingly answer—No, except for those whose business imposes on them the necessity of a cistern. Gauging the water would introduce nearly all the inconveniences of the intermittent system. As we have no water-meter applicable to the purpose, the gauging is made by means of a diaphragm placed in the delivery-pipe, which limits the supply to the consumer. This pipe abuts on a reservoir or cistern filled with a certain quantity of water only, so that the company can never give more than the quantity agreed upon. It is, therefore, easily understood that a reservoir or cistern is indispensable on this system. Many of the houses in Paris consume about 330 gallons per day. If the consumer has no reservoir, he can only draw from his spout about two pints per minute, it will, therefore, take a quarter of an hour to get a pailful. In towns where the houses accommodate several families, measuring the water would be a constant source of annoyance, unless the water were laid on separately for every household, which would occasion considerable expense. Measuring the water has, therefore, nearly the same amount of objections as the intermittent system, especially if we reflect that should a straw or small quantity of dirt get into the diaphragm the quantity of water would be considerably diminished, and thus the consumer would not receive the quantity which he bargained for.

Gauging the water being evidently injurious to the consumer, is it advantageous to the enterprise which furnishes the water? We think not, and we found our opinion on the following details.

In commerce, one is accustomed to see merchandise sold according to the quantity. Thus two or three bushels of corn cost more than one. This principle has been applied to the sale of water. Attention has not been paid, however, to the difference in the cost of production of some things as compared with others; in some cases the cost of production is in proportion to the quantity produced, in others the cost is almost independent of the quantity. The sale of water being generally a monopoly the price is subject to no competition, and it may be raised or depressed according to the views of the vendor.

For instance, a town or a company undertakes to supply water. They fix upon the source and lay down the pipes; they spend, as at Toulouse, £40,000 for 4,000 tons* of water per day. This involves an annual expense for interest of £2,000, to which must be added £400 for cost of maintenance, together £2,400. Suppose that 2,000 tons are required for the public service, fountains, cleansing streets, sewers, lavatories, &c., there will then remain 2,000 tons for private distribution. How can a tariff be framed to make the best use of this quantity?

Suppose they fix an invariable price, say 40s. per ton, and suppose they sell only one-half the quantity which they have for sale, their income will be £2,000, At this rate 1,000 tons a day will be lost both to the public and the company. Suppose, in order to avoid this, the price be lowered to 32s. per ton, and that in consequence of the reduced price the sale increases to only 1,200 tons a day, then the income will be 1,200 tons at 32s.=£1,920, so that the company would lose £80 a year by the reduction, and ought to return to its old tariff, notwithstanding the useless waste of water which this involves. At the same time it is evident that the state of things created by the second tariff is more advantageous than the first. In fact the thousand consumers who pay at the rate of 32s. in place of £2, will evidently make a saving of 8s. a year, and taking the saving at only 4s. a head to the 200 extra consumers who would not have taken it at all at £2, we have a

Total gain to the public of 1,000 tons at 8s.......	£400
200 tons at 4s.	40
Total gain to the public	£440

This is a large compensation for the loss of £80 to the company.

Let us carry the hypothesis a little further. Suppose the price of sale be fixed at 24s. per ton, and that the sale amounts to 1,500 tons. The receipts of the company will then be £1,800. It is clear that the consumers at 40s. a ton effect a saving of 16s. each, or in all £800. The consumers at 32s. effect a saving of 8s. in addition to the 4s. which they had before saved, and taking the remaining 300 consumers to save only 4s. each, the saving to the public stands thus :—

1,000 tons at 16s.	£800
200 tons at 12s.	120
300 tons at 4s.	60
Total	£980

By a tariff reduced to 24s. a ton, then, the public would save nearly £1,000, while the company would only lose £200. It is evident, then, that the kind of tariff to be adopted should be regulated by the relative importance attached to the interest of the public, and to that of the company.

(*To be continued.*)

THE PARIS UNIVERSAL EXPOSITION, 1855.

LOCOMOTIVE ENGINES.

The French and other continental nations appear to have almost universally adopted the system of outside cylinders. They have also three distinct kinds of locomotive engines—namely, one adapted for carrying merchandise at a low rate of speed, one adapted for a mean or medium rate, and passenger engines adapted for quick speed. I shall now notice some of the most interesting specimens of locomotive engines.

One, exhibited by C. Polonceau, of Paris, is said to have been built in three months. The cylinders of this engine are, in fact, under the boiler, and are inclined in direction, pointing towards the axle of the middle pair of wheels. The engine has three pairs of wheels, all coupled together, the object being the conveyance of goods.

The heating surface in this engine is	1,447 square ft.
Diameter of cylinders	17 in.
Stroke of piston	25 in.
Diameter of all three pairs of wheels	5 ft. 1 in.
Pressure of steam in boiler, equal to	8 atmospheres.
Weight of engine when empty	26·4 tons.
Weight when filled with water and coke	31 tons nearly.

Weight upon the rails for each axle when charged with water and coke :—

Front axle	10·184 tons.
Middle	10·562 tons.
Hind	10·184 tons.

* The ton here made use of is the French cubic mètre, and is equal to 220 English imperial gallons. Taking water to weigh 10 lbs. per gallon, there ought to be 224 gallons in the ton. I find, however, that many of the London Companies use a measure which they call a *tun*, in computing the daily or weekly pumping of their engines. This tun is equal to 6 barrels of 36 gallons each, or 216 gallons. I take 220 as the mean between these two. It represents with perfect accuracy the French cubic mètre, and is sufficiently exact for the English *tun* to be very convenient in calculation.

The advantages of this engine are said to be :—

1. Easy access to all parts for cleaning and repairs.
2. Augmentation in surfaces of adhesion, and consequent diminution of wear and tear.
3. Lowering the centre of gravity for the boiler, and procuring greater height of chimney.
4. Diminution in expense of working and repairs.

Five machines, constructed on this principle in 1850, are said to have run together 675,000 kilometres, or nearly 420,000 miles, and have only cost, for working and repairs, ·96 francs per kilometre, or about 15 pence per English mile.

E. Gouin and Company, of Paris, exhibit several mixed machines from the Railway du Midi.

These engines have three pairs of wheels—the two hind pair being driving-wheels. The cylinders are outside, under the foot-boards ; they are horizontal, and level with the axis of the larger or driving-wheels. The valve-case is at the top of the cylinders. The engine and tender are combined in this machine.

The surface of fire-grate is	96 square ft.
The heating surface of 180 tubes	1,060 square ft.
Diameter of cylinders	17 in.
Diameter of each pair of driving-wheels	5 ft.
Weight for adhesion on two pairs of driving-wheels	27 tons.

Another combined engine, by Gouin, has two boilers, one above the other, and the following dimensions :—

Area of fire-grate	111 ft.
Heating surface of 195 tubes	1,195 ft.
Diameter of cylinders	18 in.
Stroke of piston	31 in.
Diameter of two pairs of driving-wheels	9 ft. 4 in.
Weight upon the four driving-wheels	28 tons.

Crampton's engines for passengers, with outside cylinders and one pair of large driving-wheels. In these engines the cylinders are half above and half below that which is the foot-board in other engines. The wheels are six in number, but only the third pair is used for driving. The axis of the cylinder is inclined towards the axle of the large driving-wheels. The valve-case is placed obliquely over the cylinder.

The fire-grate in these engines has an area of...	66 square ft.
The tubes, 215 in number, have a surface of ...	944 ft.
Diameter of cylinders	16 in.
Stroke of piston	22 in.
Diameter of driving-wheels	7 ft.
Distance between extreme axles	14 ft. 3 in.
Elevation of axis of cylinders above surface of rails	5 ft $1\frac{3}{8}$ in.
Total weight of engine when empty	27 tons.
Weight on each driving-wheel when charged—$6\frac{3}{4}$ tons for both wheels	$13\frac{1}{2}$ tons.
On each of the other four wheels four tons, or in all	16 tons.
Total weight when charged	$29\frac{1}{2}$ tons.

Mr. Crampton gives a table of twelve of these engines, built for the Northern Railway of France. The average distance travelled by each engine in six years appears to be 152,130 miles, or 25,355 miles a year.

These engines are not very elegant in appearance ; but though not very handsome to look at, they are said, nevertheless, to be good at going. Ten engines of this pattern have lately been ordered for the Grand Duchy of Baden ; and Mr. Crampton states they have been running for nine months at a mean rate of 64 kilometres, or nearly 40 English miles an hour.

Amongst the English engines exhibited are one by Robert Stephenson, of Newcastle, called the *Emperor*, and one called the *Eugénie*, designed by M'Connel, of the London and North Western Railway, and built by Fairbairn. Both these engines have inside cylinders under the front part of the boiler, and are driven by the middle pair of wheels.

Schneider and Co.'s engine for the Paris and Lyons Railway. The cylinders here are placed outside the boiler, and under the foot-board. The engine has three pairs of driving-wheels, all the same size, and all coupled together ; the wheels are of the same diameter as in Polonceau's engine, already described. The axis of cylinder is horizontal, in the same plane as the centre of the wheels. The slide-valves are above the cylinder. The centre of gravity appears to be lower in this engine than even in Polonceau's.

An engine called *La Ville de Genève*, by André Koechlin and Co., of Mulhouse, Haut-Rhin. The cylinders are outside the boiler, under the foot-board. The two hind pairs of wheels are drivers, each 5 ft. in diameter. The front wheels are smaller. The slide-valves here are on the inside of the cylinder, and are under the boiler.

Engine by Cail and Co., from the Lyons Railway. This is a passenger engine, with outside cylinders under the foot-board, connected with only the centre pair of wheels.

The celebrated Cockerill Company, of Seraing, in Belgium, has a goods' engine, with eight driving-wheels (system Engerth). These engines are said to be capable of taking trains consisting of forty-six waggons and weighing 670 tons at a rate of 26 kilometres, or 16 English miles an hour, on inclinations of 1 in 250. The engine exhibited is called the *Duke de Brabant*. It has outside cylinders, and four pairs of driving-wheels, all the same size. The boilers are circular. The cylinders are placed very low, in line with the axles of the wheels. The valve-case is on the top of the cylinders.

There is a fine engine called the *Elslingen*, from Wurtemburg, with four wheels, of which the two hind ones are the driving-wheels. The slide-valves are above the cylinders.

Prussia exhibits a handsome locomotive engine, by Borsig, of Berlin, the price of which is marked 64,000 francs. This engine has six wheels, and outside cylinders working one pair of driving-wheels, this being the middle pair. The slide-valves are inside the cylinders, and are under the boiler. This is an elegant form of outside cylinder engine.

Combined engine and tender, built at Vienna, for the railway company from Vienna to Raab. This engine has eight wheels, all of equal size, and a good wide foot-board on both sides. The cylinders are outside the boilers, and under the foot-board, in the front part of the engine. The valve-cases are outside the cylinders. The wheels are blocked up solid with wood.

Two Belgian engines are exhibited, with round boilers, outside cylinders, and a foot-board again outside the cylinders. These engines have each six wheels, the middle being the driving pair.

At the Exposition of 1839 railways had made such feeble progress in France that no locomotive engines were exhibited, but at the next quinquennial Exposition, namely, in 1844, more than 400 miles of railway had been opened, including the lines from Paris to Rouen and from Paris to Orleans. The construction of locomotives had then become a subject of truly national importance. The jury of 1844 accordingly awarded gold medals to Messrs. Meyer, of Mulhouse, and Durenne, of Paris, for the engines which they exhibited.

The engine called the *Mulhouse*, built by M. Meyer, was tried since 1843 against all the locomotives working on the Versailles railway (Rive Gauche), and was found to consume only 16 lbs. of coke per English mile, whilst all the other engines consumed 23 lbs. per mile.

Compared, also, with the English engine, *Vauban*, constructed by Robert Stephenson and Co., of Newcastle, and working on the Orleans Railway, the two engines were each found, when working with trains of 60 or 70 tons, to consume the same quantity of coke, namely, 18 lbs. per English mile. At the same time, however, it is said the French engine required 15 to 19 per cent. less water than the English.

In consequence of these experiments the French maker contended that his engine, on the whole, was superior to the *Vauban*, and that the equal consumption of coal by the two engines was due to the fact that the boiler of the English engine economised to the greatest extent the heat developed by the combustion of the coke.

The jury of 1849 awarded gold medals to Messrs. Flachal, civil engineer, of Paris, Ernest Gouin and Co., of Batignolles, and Bourdaloue, civil engineer, of Bourges, for their improvements in locomotive engines. M. Cail and M. Gouin, who exhibit largely at the present Exposition, have both been decorated with the Cross of the Legion of Honour,—the former in 1844, and the latter in 1849.

STEAM-ENGINES.

Most of the French engines up to 20 H.P. are horizontal direct-acting engines. Some of these engines are very small, there being one of only 2 H.P., and weighing only about 300 lbs.; the price of this small engine is 700 francs, or £28 sterling. The construction of these horizontal engines is very similar to that by Ransome, which has been already mentioned. Some of them work very fast, there being one of 6 H.P. employed in driving the long shaft for machinery in motion, which is making about 300 revolutions, or double strokes, per minute.

A 15 H.P. engine, with horizontal cylinder, piston-rod working between guides, steam cut off at 1-4th of the stroke. Price, without driving-pulley and setting........6,500 francs

Driving-pulley and setting	500 „
	7,800 „

or £280, equal to something less than £19 per H.P.

No. 837 (France) is a double-cylinder oscillating engine of 18 H.P., working with a pressure of 2 atmospheres. Price, 13,000 francs, or £520, equal to £29 per H.P.

Another engine by the same exhibitor, M. Casalis, of St. Quentin, is a condensing steam-engine of 12 H.P., on the principle of Woolf; the slide-valves are worked by an eccentric fixed on a shaft, which takes its power from a crank fixed on the main-shaft. Price, 12,000 francs, including boiler, or £480, equal to £40 per H.P.

Messrs. Cail and Co., of Paris (No. 835 in the Catalogue for France), exhibit several engines, one of which is a horizontal cylinder direct-acting condensing-engine, of 20 H.P. This engine makes 80 double strokes per minute. The steam is cut off at from 1-15th to 3-5ths of the stroke. The consumption of coal in this engine is said to be only 1½ kilogrammes or 3·3 lbs. per H.P. per hour.

M. Rouffet, the elder, of Paris, exhibits a horizontal direct-acting engine of 15 H.P., working at high-pressure; also a small 4 H.P. portable engine, with tubular boiler.

M. Mariolle-Pinguet, of St. Quentin, exhibits a direct-acting horizontal engine, with a clothed cylinder, and unusually long stroke. The piston-rod does not move between guides in this engine, but is carried at the extremity of an oscillating beam, suspended vertically, which much diminishes the friction.

Amongst the larger class of steam-engines there are several remarkable for their small consumption of coal.

A condensing beam-engine of 60 H.P., with a double cylinder, exhibited by Thomas Pavel, of Rouen, is said to require only 3·3 lbs. of coal per H.P. per hour. The experiment to determine the consumption was made by M. Slowicki, civil engineer, who used a very superior kind of dynamometer to ascertain the exact H.P. employed. The engine, which is sold for 60 H.P., was worked for five consecutive hours, after getting up the steam, with a force of 86·8 H.P., and the consumption per hour per each H.P. was found to be 1·49 kilogrammes, = 3·29 lbs. avoirdupois.

An engine of 20 H.P., made by M. L'Hereux, of Rouen, was subjected to a similar experiment, and when worked up to a power varying from 31 to 33·12 horses, was found to consume from 1·21 to 1·85 kilogrammes of coal per hour for each H.P. The average of five hours working was 1·5 kilogrammes, or 3·3 lbs. avoirdupois. This is also a condensing beam-engine with two cylinders.

M. Lecouteux, of Paris, exhibits a beam-engine with two upright cylinders of 30 H.P. This engine makes thirty-five double strokes per minute, and the steam is cut off at 1-7th of the stroke. This engine can be worked either condensing or high-pressure, and either one or both cylinders may be worked. Consumption, 1·6 kilogrammes of coal or 3·53 lbs. avoirdupois per hour for each H.P.

The manufacturers of Rouen are famous throughout France for their engines. One of them of 25 H.P., consuming 3·3 lbs. of coal per hour for each H.P., complete with boiler of 35 H.P., is marked 4,500 francs, or £1,800 sterling. There are many other engines from Rouen besides those which have been mentioned. One of these is a 40 H.P. engine, by Lacroix, which is said to have obtained a prize medal in London in 1851. This is a double cylinder beam-engine. Also, a 40 H.P. engine, by Thomas Scott, of Rouen.

M. Isidore Farinaux, of Lille, exhibits an engine with two horizontal cylinders, working expansively, on the system of Woolf. The stroke of the piston is 3 ft. 3 in.; they make thirty double strokes per minute, and the diameter of the larger cylinder is 28 in., that of the smaller being 14 in.

Messrs. Cail and Co., of Paris, exhibit a condensing direct-acting horizontal cylinder engine of 30 H.P. This engine makes 48 double strokes per minute, and the steam can be cut off at any part of the stroke, from 1-18th to 3-4ths. The consumption of fuel is said to be only 1·33 kilogrammes per hour, or less than 3 lbs. avoirdupois per hour for each H.P.

Several French engines are employed in turning the long shaft for working the machinery in motion. Most of these are double-acting horizontal engines, and several of them have as much as 25 H.P.

One of these horizontal cylinder engines by Farcot, of St. Ouen, near Paris, is said to consume only 1·10 to 1·33 kilogrammes of coal, or from 2·4 to 3 lbs. avoirdupois per hour for each H.P.

Another French engine, used for driving the machinery in motion, is by Flaud, of Paris, No. 852 in Catalogue. This is a condensing-engine of 20 H.P., with double vertical cylinder. The crauk-shaft of this engine makes 300 revolutions per minute.

There are about 70 French exhibitors of steam-engines, these being placed in the 6th section of Class IV.

AUSTRIAN ENGINES.

There are five exhibitors of engines from Austria. One of these engines, by Schmid, of Vienna, is employed for driving the machinery in motion. This is a condensing beam-engine, with a double vertical cylinder. The governor and slide-valves are both worked by spur-wheels from the main shaft. The crank makes about 60 revolutions per minute.

BELGIAN ENGINES.

There are three Belgian exhibitors of steam-engines. The one which is used for driving the machinery in motion being exhibited by Lestor-Stordeur, of Houdeng-Aimeries, in Hainhaut. This is an engine with two oscillating cylinders, suspended on a horizontal axis, and vibrating vertically. The price of these engines is advertised from 5 H.P. up to 30 H.P. The 5 H.P. engine is 1,000 francs, or £40. Each increase of 5 H.P. adds £40 to the price, so that a 30 H.P. engine is charged 6,000 francs, or £240. This price is exclusive of boilers, but still is remarkably small, being only at the rate of £8 for each H.P.

GREAT BRITAIN.

From the United Kingdom there are fourteen or fifteen exhibitors of fixed engines, among whom are Rennie, Seaward and Capel, besides Ransome and Sims, and other makers of agricultural engines. The principal English steam-engine employed in working the machinery in motion is by Fairbairn. This is a good sample of the engines used in Lancashire for manufacturing purposes, and it works several of the spinning, carding, and throstling machines exhibited by Platt and Co., of Manchester.

The cylinder of this engine is upright, with the piston-rod working n guides, and turning a cranked axle placed over the cylinder. On this axle is fixed a large and heavy toothed wheel, which serves also as a fly-wheel. The cranked axle turns the vertical shaft of the governor, and also works the eccentric for opening and closing the slide-valve. This engine is very badly put up, owing probably to inattention on the part of the workmen entrusted by Mr. Fairbairn. Several of the columns supporting the driving-shaft are quite unsteady on their foundations, so that the working of the engine has by no means a fair chance.

There are five American engines exhibited, one of which, a pumping-engine, has oscillating cylinders.

MAGNETIC GAUGE FOR STEAM-BOILERS.

This is said to be the first application of magnetism to steam-boilers. The apparatus consists of a metallic hollow spheroid suspended by an iron rod, the end of which is a bar of steel strongly magnetised. This magnet rises and falls in a brass box, which serves as a sort of cage to enclose it. Upon the face of this box, which is graduated in centimetres or inches, moves a small needle or pointer, separated from all mechanical support, but attracted only through the loop of the magnet, all of whose motions it follows. The extreme limits of the floating ball can only be reached by touching the stops which open the alarm-whistle, so that a failure or an over-supply of water is immediately detected. The graduated surface of the gauge is silvered, so that the continual motion of the pointer is readily seen at any distance.

The apparatus is protected by a glass cover, which preserves the needle from injury and keeps the graduated scale constantly clean.

The price of the gauge, without the valve, is from 170 to 180 francs, and the gauge and whistle from 30 to 90 francs extra.

Notwithstanding the uumerous specimens of condensing-engines which the French exhibit, there can be no doubt that high-pressure non-condensing engines are more extensively used and preferred throughout France, both for fixed and marine engines. These are commonly made to work expansively, and the French claim a great advantage, both in first cost and the expense of working. They say that the fixed engines used in England weigh nearly 1 ton for each H.P., and require great outlay both for erection and working, while the French engine weighs only 13 or 14 cwt. per H.P., requires less care in management, and is less subject to accident.

The French have been making strenuous efforts to improve their steam machinery ever since the Exposition of 1839, when more than forty steam-engines were exhibited. The principal French manufacturers who have been favoured with medals at former expositions, are, Messrs. Saulnier, of Paris; Stehelin and Huber, of Bitschviller (Haut-Rhin); Schneider Brothers, of Creuzot; Casalis and Cordier, of St. Quentin; Cavé and Meyer, of Mulhausen; Farcot, of Paris; Lemaître, of Chapelle Saint Denis; and Bourdon, of Paris. Messrs. Saulnier, Pecqueur, Bourdon and Farcot, have also been created Chevaliers of the Legion of Honour for their improved steam-engines, exhibited at the expositions of 1839, 1844, and 1849.

(To be continued.)

IRON MORTAR-BOATS.

By LAIRD, Birkenhead.

THE great interest which attaches to the various kinds of vessels for war purposes, of which so mauy are now in the course of construction for operation in the shallow waters of the Baltic, and which are intended more particularly to approach within effective range of such of the granite fortresses and other maritime defences of Russia as have been erected in narrow, tortuous channels, beyond shoaly and difficult navigations, whether natural or artificial. We give below a longitudinal (Fig. 1) and a transverse (Fig. 2) section of one of the iron mortar-vessels built by Laird, of Birkenhead, being the one recently tried with complete success. By the report of the officers of the *Excellent*, gunnery-ship, nothing could exceed the satisfactory nature of their experiments with this vessel. Upwards of 180 rounds were fired, continuously, on the first trial, and again, 80 rounds on the second occasion, without any other damage resulting than that of a few rivets and slight fittings having been started.

We know that many naval officers of high standing view the use of iron, as a material for building war vessels, with great distrust; we believe, however, that but for the introduction of iron for those purposes it would have been impossible to have turned out such an immense flotilla of war vessels in the very limited period which has been allotted for the building and equipment of these new additious to the Baltic and Black Sea Fleets, intended for active operations in the spring. In another part of our Journal our readers will find a list of vessels in the course of construction and uuder contracts to be delivered at various dates early in the spring, which, we think they will agree with us, forms a truly magnificent picture of the resources of our Island in this branch of industry; for, be it observed, these so important results are all effected by the use of native material and domestic industry only, thus showing to our enemy, and to the world, that within our own sea-girt land there existed, waiting only to be called into action, the means of "solution" (to use a pet diplomatic expression) of Russia's vaunted impregnability.

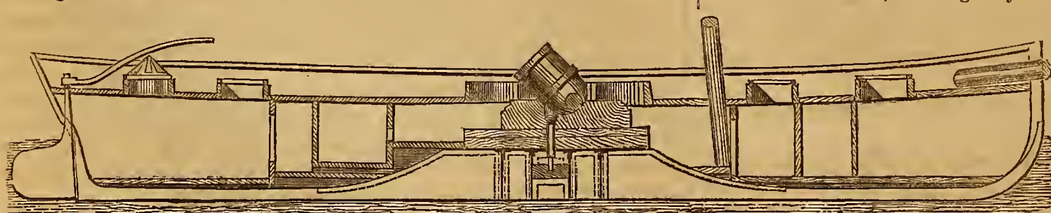


Fig. 1.

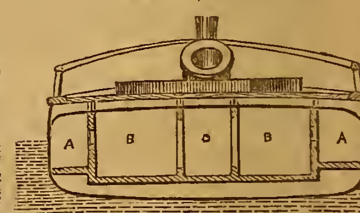


Fig. 2.

The dimensions of the above vessel are as follow: length over all, 62 ft.; width over all, 20 ft.; depth from deck to keel, aft, 5 ft. 6 in.; draught of water, aft, about 4 ft. 6 in. She is fitted with one mast and a bowsprit.

The mortar is placed in the centre of the vessel, mounted upon large wooden bed-pieces, capable of revolving on a centre stud, as shown in the longitudinal section. These bed-blocks are secured upon a wrought-iron framed foundation, being a continuation of the keel-plate, the whole forming a solid resisting surface, by which the force of the recoil is distributed over a greatly-increased area, whereby the vessel is relieved from the strain on each discharge, which otherwise would tend to cripple her at that point.

An octagonal hatchway, with a moveable cover, encloses the mortar when not in use, and the general arrangement of the parts will be seen in the longitudinal section.

In the transverse section, A, A, are light rooms; B, B, magazines; and C, the handing-room, by which the magazines are approached, and from which are received the charges.

ENGINES AND MACHINERY OF THE "ARABIA," AND OF THE "LA PLATA."

By Messrs. R. NAPIER and SONS.

WE present our subscribers this month with a magnificent Plate of the engines and boilers of the above paddle-wheel steam-ships, exhibiting a longitudinal section of the engine-room between the bulkheads, and conveying very accurately a most comprehensive view of the general arrangement, there being a side elevation of one of the engines, a front elevation of one boiler abaft and one before the engine, with their separate steam-chests, funnels, and waste-steam pipes in section; main-deck with deck lines, paddle and engine beams; the water casings around the funnels; hatchways, stairs, and platforms; engine and boiler keelsons; frames of the ship, and keel, &c.

The general dimensions and particulars of the magnificent specimens of naval architecture into which these engines were fitted, have been noted by us already in THE ARTIZAN, and we hope shortly to be enabled to compare the results obtained by these vessels with those of the new iron steam-ship *Persia*, a vessel 1,294 tons B.M. larger than the *Arabia* and *La Plata*, although the nominal power (per Admiralty) of the engines of the *Persia* is 23 H.P. less.

The cylinders of the *Arabia* and *La Plata* are 103 in. diameter × 9 ft. stroke. The air-pump is 60½ in. diameter × 4 ft. 7 in. stroke. The extreme length of sole plate, 30 ft. Length of side-levers between centres, 21 ft. 11 in. Distance between centres of cylinders, 15 ft. 10 in. The paddle-wheels are 35 ft. 6 in. diameter over floats; each wheel has 28 radial floats, 10 ft. 6 in. × 3 ft. 2 in. There are 4 tubular boilers, 2 afore and 2 abaft, fixed athwartship, there being 24 furnaces in all, with a fire-bar surface in each of 8 ft. 4 in. × 3 ft. 2½ in, or = 642 ft. area of grate surface; the total area of heating surfaces = 16,948 sq. feet.

The indicated H.P., given in a series of diagrams, sufficiently speaks of the excellence of the working results. One figure shows 2,828 H.P., the speed of pistons being 243 feet per minute (13½ revolutions), with steam at 12·35, vacuum 10·60 above, and 11·81 steam, and vacuum 11·34 below, working *without* expansive gear.

These vessels were built in 1852, by Mr. R. Steele, and both vessels and engines have given constant satisfaction to their respective owners.

Having glanced thus slightly at the engines and machinery of these magnificent vessels, we have a few words to add respecting the Plate, to which we call special attention, as there are few works of this character with which the beautifully-executed Plate we now present can be compared as a work of art.

Mr. David Kirkaldy, the talented engineering draughtsman, to whose skill we are indebted for the drawing from which the accompanying Plate was engraved, has received from the Jurors of the Paris Exposition, 1855, a medal for the artistic excellence of his drawings and for the correctness of his delineations of the practical details of engines and machinery constructed by Messrs. R. Napier and Sons, which were drawn and exhibited by Mr. Kirkaldy in a goodly number.

Since the close of the Paris Exposition, Mr. Kirkaldy has made a selection of the Plates of the engines, boilers, &c., of the two vessels referred to, and has added some excellent letterpress descriptions and tabulated matter, giving the principal dimensions of the ships and their internal fittings, &c.; the engines, boilers, and machinery; indicative diagrams of their performances, and other useful information. The manner in which Mr. Kirkaldy has drawn and described these works, in a large folio volume, published by Mr. William Mackenzie, the well-known publisher of London, Edinburgh, and Glasgow, is deserving of the highest commendation.

There are nine large Plates of the same size as the one we present to our readers this month, and all drawn and engraved in the same excellent style. The boilers and other parts of the work are given accurately in detail, and there are letters of reference on the parts corresponding with the letterpress description at the end of the work.

The text includes—1st. The enumeration and description of the Plates, carefully done.

2nd. A page of literal references to the engines,—Plates 4, 5, and 6.

3rd. A description of the action of the engines, very fully entering into the details of their working parts, and giving a tabulated statement of the indicated working of the engines.

4th. Literal references to the boilers,—Plates 7 and 8.

5th. A description of the boilers, and an explanation of their working.

6th. A statement of the materials used in the construction of the engines, boilers, &c.

7th. An excellent description of the vessels.

And lastly, a table of the principal dimensions of all the steam-ships built for the British and North American Royal Mail Steam Packet Company, the machinery for which have been constructed by Messrs. R. Napier and Sons, Glasgow.

We noticed very briefly in our last Number this very excellent work, the production of Mr. D. Kirkaldy, which has been published in excellent style by Mr. Mackenzie; and we take this opportunity of acknowledging our obligation to both these gentlemen, for this very splendid addition to the illustrative works on the marine engines of Great Britain, as also for their permission to illustrate our notice of the engines and machinery of the *Arabia* and *La Plata*, with the accompanying plate.

THE WAR.—HAS ENGLAND MAINTAINED ITS ENGINEERING SUPREMACY?

"I was born in a land where men are proud to be, and not without cause."—BYRON.

WE have no desire to make our columns the medium of self-glorification and egotism, nor to prick up our ears and take offence at the disparaging remarks which appear from time to time in the columns of many of our leading journals on the state of engineering science in England at the present day, in relation to the conduct of the war; but we have lately observed a morbid desire with some of our contemporaries to crush the spirit of *nationality*, and an apparent desire to cultivate a closer alliance with our allies, the French, by sinking into oblivion the great deeds and great names of the past. With such ideas as these we can have no sympathy—we cannot wish to blot out from our history some of its brightest pages, nor acknowledge that though our fathers have bravely struggled, suffered, and bled for their country, that we, their descendants, are now ashamed of their actions. Such is not the way to win the esteem of a brave nation like the French.

Britain can well afford to look down with composure on the many disparaging remarks of her enemies; whether these appear on the continent of Europe, or from those who speak her own language and enjoy her free institutions. These enemies assert (no doubt "the wish is father to the thought") that she is now *descending* from her place as one of the first of nations,—that her sons have become enervated through prosperity and wealth,—that her governing classes have, from long prosperity and undisturbed successes, become haughty, proud, and utterly unfit for a great emergency,—and that the engineering and scientific skill for which she once stood unrivalled has passed away. We say that we are not surprised when we hear such statements from our open and avowed enemies; but when we see Britain's sons, those who seek to lead public opinion, echoing and chiming in with such sentiments, as if they could, by such humility, gain the esteem of either friend or foe, we say we cannot allow such sentiments to pass unheeded as beneath our notice.

We would say to those who are anxious for Britain's *star* to go down, that it is still far from the *meridian*; that in this war, if the hair has only been pulled, and the toes scratched, of barbarism,—that to do even this the British Lion has hardly stirred from his recumbent position. England has not yet appealed to the hearts of her noble sons,—she has not yet put the trumpet to her mouth to recall the fathers who have passed away—Wallace and Bruce, Cromwell, Marlborough, Nelson, and Wellington.

In all that goes to make a free, a great, a noble nation, Britain will yield the palm to none. She cannot forget that long, long ago her sons fought, and bled, and conquered in the cause of civil and religious liberty; that of the many bright names in the galaxy of her great men, Newton, Watt, and Stephenson are only a few of the many who have given their energies and talents to practical science. She cannot forget that these men have given to England and the world the steam engine, ocean steam navigation, the railroad, and the locomotive, and in so doing they have proved the world's greatest benefactors.

We have no desire to put our country in an antagonistic position, or to stir up prejudices which had better be forgotten, but we cannot bear to let go our high position, or to descend even *one step* from our elevation; on the contrary, we would still seek to climb another round of Fame's ladder, and bring up, not cast down, those by whom we are surrounded.

The wars which closed with Waterloo proved that we had then a brave army and great generals;—it is now asserted that we are not a military people. But we affirm to the contrary: if the military operations of the last two years have not been attended with results so striking and decisive as we had fondly hoped and anticipated, we would gravely inquire whether this be not due to the system on which the army is at present officered. If so, let the nation see to this: they have only to *will* it in downright earnestness, as was done in the case of the Corn Laws, and the obnoxious system of purchased commissions will soon be numbered among the things that were. Our soldiers will then worthily emulate the deeds of their forefathers, and proudly maintain the honour and military reputation of Great Britain.

One thing we regret, and that is, that from the long peace which has blessed our land we have nearly all been lulled into security. We are conscious of bearing a great hereditary name, but from the peaceful times we have had, the present generation has never before been called to any great *national effort*, and patriotism, to many, is only but a name,—hence the difficulty of rousing our countrymen.

It will be remembered by our readers that we were amongst the first to offer suggestions relative to the active prosecution of the war, and we ventured to assert that this country was in possession of unlimited means, whether it were in engineering skill or material for the construction of new and more powerful ordnance, or in such an extension and adaption of our navy as would be required for the altered circumstances of the times. We ventured to suggest that the private firms in the various parts of the country would be too glad to join their efforts in assisting the Government in the prosecution of the war. The following extract from the "Times" of the 7th ult., will, therefore, be read with pleasure and interest:—

"The principal engineering foundries in Liverpool have the whole of their hands occupied in the manufacture of immense projectiles and enormous pieces of ordnance. At the Mersey Iron Works, in addition to the monster wrought-iron gun, to weigh 24 tons, and to throw a ball of 300 lbs. upwards of five miles, they are constructing two wrought-iron mortars capable of throwing a shell of 36 in. diameter. At Fawcett and Preston's they are executing an order for ninety mortars for 13 in. shells; about fifty for sea and forty for land service. At the Vauxhall Foundry immense quantities of 8, 10, and 13 in. shells have been constructed for some time, upwards of 7,000 tons of which have been made during the past six months, and during the last ten days they have shipped 1,400 tons of shells to Woolwich; this firm is also making several dozens of 10 and 13 in. mortars for land and sea service, and two experimental cast-iron mortars, to throw 18 in. shells, which, it is believed, are to be called the 'Palmerston Pacificators.' Mr. Laird is also building fourteen screw gunboats of 240 tons and 60 H.P. each."

We will now proceed to answer the question put at the head of this article, more especially in regard to the state of our Royal Navy. Whatever difference of opinion may exist as to whether we should or should not be a great military nation, all agree that the "sea is all our own;" that "England's best bulwarks are her wooden walls." We are pleased that it is so, and we would beg to submit a few facts and figures to prove that what has been done in England these last ten years could not have been done by any other nation. We are not uttering the words of bravado, but the words of truth and soberness.

In 1845 our gracious Queen reviewed the Fleet at Spithead, when the germ of the screw steam-fleet was present in the shape of a single ship of 200 H.P. and 800 tons, the *Rattler*. The Queen again reviewed the Fleet in 1853, when the screw steam-fleet had increased on that grand and memorable spectacle to thirteen ships, equal to 5,550 gross nominal H.P., 24,226 tons, and carrying 664 guns; and the whole number of screw-ships, of all classes, in that year, may have been between forty-five and fifty.

The following Table, carefully compiled, will at once carry conviction to the mind of the most unbelieving that we are still taking the lead in all that pertains to engineering skill and naval resources. Now, we have ready, or will have in the next three months, for service in the Baltic or elsewhere, 217 screw steam-ships of all classes, having 32,922 gross H.P., and carrying 3,552 guns. We need hardly remind our readers that the above are exclusive of the Black Sea Fleet and screw-ships on other stations, which will number, in addition, about forty-six ships, making a grand total, from one solitary screw-ship in 1845, to about fifty in 1853, and now, in 1856, 263 screw steam-vessels of war.

In the early part of last year we noted, with great pleasure, the introduction of high-pressure steam in ships of war; only seventeen short months have elapsed since the first was tried, and it will appear, by the Table, that we have now 140 high-pressure ships in all, equal to 7,940 H.P., and carrying 316 guns.

BALTIC FLEET, 1856.

LINE OF BATTLE SHIPS AND HEAVILY ARMED FRIGATES.

Names.	H.P.	Guns.	Names.	H.P.	Guns.
Duke of Wellington	700	131	Sanspareil	350	71
Marlborough	800	131	Hastings	60	60
Royal George	400	102	Pembroke	60	60
St. Jean d'Acre	600	101	Cornwallis	60	60
Conqueror	800	101	Hawke	60	60
Exmouth	400	91	Russell	60	60
Nile	500	91	Blenheim	450	60
James Watt........	600	91	Hogue	450	60
Cæsar	400	91	Ajax	450	58
Algiers	450	91	Edinburgh	450	58
Victor Emanuel	600	91	Euryalus	400	51
Orion.............	600	91	Impérieuse	360	51
Princess Royal.....	400	91	Shannon	600	51
Renown	800	91	Sutlej	600	51
Majestic...........	400	81	Liffey	600	51
Cressy	400	81	Chesapeake	400	51
Brunswick	400	81	Arrogant	360	47
Colossus	400	81	Amphion	300	34
Mars	400	81	Retribution	400	28

Total............ 16,520 H.P. 2,812 Guns.

CORVETTES AND STEAM FRIGATES.

Names.	H.P.	Guns.	Names.	H.P.	Guns.
Cadmus	350	21	Malacca	200	17
Cossack	250	21	Harrier............	100	17
Pylades	350	21	Magicienne	400	16
Esk................	250	21	Wasp	100	14
Tartar	250	21	Cruizer	60	14
Pearl	400	21	Archer............	202	14
Satellite	400	21	Ariel	60	9
Challenger.........	350	21	Conflict	400	8
Falcon	100	17	Desperate..........	400	8

Total .... 4,622 H.P. 302 Guns.

SMALLER STEAMERS OF THE OLD CLASS.

Names.	H.P.	Guns.	Names.	H.P.	Guns.
Basilisk	400	6	Dragon............	560	6
Bulldog	500	6	Driver	280	6
Sampson	467	6	Inflexible	378	6
Virago	300	6	Prometheus........	200	5
Vixen.............	280	6	Janus	220	4
Geyser	280	6	Merlin	312	4
Vulture	470	6	Firefly	220	4
Gorgon............	320	6	Pluto	100	4
Centaur	540	6	Cuckoo	100	3
Devastation........	400	6	Porcupine	132	3

Total............ 6,459 H.P. 105 Guns.

DESPATCH GUN BOATS.

Names.	H.P.	Guns.	Names.	H.P.	Guns.
Pioneer............	350	6	Surprise	200	4
Flying Fish	350	6	Renard............	200	4
Intrepid	350	6	Sparrowhawk	200	4
Nimrod............	350	6	Vigilant	200	4
Roebuck...........	350	6	Cormorant	200	4
Victor.............	350	6	Wanderer..........	200	4
Alacrity	200	4	Foxhound	200	4
Coquette	200	4	Assurance	200	4
Mohawk	200	4	Coromandel........	200	4
Osprey	200	4	Lapwing	200	4
Ringdove	200	4			

Total............ 5,100 H.P. 96 Guns.

FLOATING BATTERIES,

With *non*-condensing engines; boiler-pressure, 60 lbs. on the square inch.

	H.P.	Guns.		H.P.	Guns.		H.P.	Guns.
Thunder ..	200	14	Trusty....	200	14	Etna	200	14

Total .... 600 H.P. 42 Guns.

HEAVY MORTAR SHIPS.

Names.	H.P.	Guns.	Names.	H.P.	Guns.
Seahorse	200	12	Eurotus	200	12
Forth	200	12	Horatio...........	250	8

Total .... 850 H.P. 44 Guns.

GUN BOATS AND MORTAR VESSELS CARRYING TWO HEAVY PIECES OF ORDNANCE,

With non-condensing engines; boiler-pressure, 60 lbs. on the square inch.

	H.P.		H.P.		H.P.		H.P.
Badger	60	Tickler	60	Gnat	20	Mastiff	60
Gleaner	60	Hyena	60	Rambler	20	Rainbow	60
Nightingale	60	Sandfly	60	Tiny	20	Grappler	60
Spanker	60	Charon	60	Ripple	60	Growler	60
Spey	60	Traveller	60	Hardy	60	Highlander	60
Opossum	60	Cheerful	20	Havock	60	Ant	20
Goldfinch	60	Jackdaw	60	Haughty	60	Rocket	60
Banterer	60	Seagull	60	Angler	20	Sepoy	60
Beaver	60	Chub	20	Beacon	60	Albacore	60
Starling	60	Julia	60	Blazer	60	Amelia	60
Partridge	60	Savage	60	Garland	20	Blossom	20
Goshawk	60	Violet	60	Rose	60	Surly	60
Pelter	60	Cockchafer	60	Spider	60	Redbreast	60
Staunch	60	Lark	60	Swan	60	Raven	60
Grasshopper	60	Shamrock	60	Magnet	60	Brave	60
Biter	60	Weazel	60	Manly	60	Brazen	60
Griper	60	Dapper	60	Onyx	20	Camel	60
Bouncer	60	Leverett	60	Bullfinch	60	Fly	60
Pincher	60	Sheldrake	60	Prompt	60	Fidget	20
Stork	60	Whiting	60	Quail	60	Dwarf	20
Bullfrog	60	Wolf	60	Flirt	20	Primrose	60
Hasty	60	Skipjack	60	Flamer	60	Delight	60
Plover	60	Louisa	60	Earnest	60	Pheasant	60
Swinger	60	Dove	60	Escort	60	Decoy	20
Bustard	60	Fervent	60	Erne	60	Wave	60
Procis	60	Mackerel	60	Daisy	20	Confounder	60
Thistle	60	Skylark	60	Pet	20	Peacock	60
Carnation	60	Snap	60	Crocus	60	Pert	20
Herring	60	Snapper	60	Parthian	60	Nettle	20
Redwing	60	Magpie	60	Caroline	60	Pickle	60
Thrasher	60	Forrester	60	Insolent	60	Porpoise	60
Charger	60	Forward	60	Midge	20		
Hind	60	Mayflower	60	Lively	60		
Ruby	60	Foam	60	Misletoe	60		
	2,040		1,960		1,640	GrandTotal,	7,220

Æolus, store ammunition-ship. *Belleisle*, hospital-ship.
Volcano, floating factory.

SUMMARY.	No.	H.P.	Guns.
Line of Battle Ships and Heavily-armed Frigates	38	16,520	2,812
Corvettes and Steam Frigates	18	4,622	302
Smaller Steamers of the old class	20	6,459	105
Despatch Gun Boats	21	5,100	96
Floating Batteries	3	600	42
Heavy Mortar Ships	4	850	44
Gun Boats and Mortar Vessels carrying two heavy pieces of ordnance on an average	137	7,220	266
Auxiliary Ships	3	140	—
Grand Total	244	41,511	3,667

All of the above, with the exception of the ammunition-ship and hospital-ship, are propelled by steam.

THE ENGINEERS OF THE ROYAL NAVY.

The great increase which has taken place in the Steam Navy has created a demand for engineers, and the question naturally arises, are we getting the right material,—men who, from their skill and experience, are thoroughly capable of taking charge of the machinery, and of performing the responsible and arduous duties of engineers at sea. We can safely reply in the negative: and that it is due to the disagreeable and anomalous position in which engineers in the Royal Navy are placed, that few men, practically qualified from their previous services in the mercantile steam marine, can be induced to volunteer for the Royal Navy. Amongst many grievances of which the Navy engineers justly complain, we will endeavour to find space for those which deserve our most serious and immediate attention, for it is a subject of national importance that the Admiralty should be always able to command the services of the best sea-going engineers.

First,—with regard to *pay*. Chief engineers in the Navy, though having a great responsibility as to the machinery, coals, stores, &c., receive 50 per cent. less per annum than the pay given in any respectable steam shipping company, at the same time their expenses of mess, and in other particulars, are very much greater. There are *three* different classes of *chief* engineers, and the third class only receive £14 a month. On reference to the "Navy List" it will be found that the bulk of the engineers belong to this class, thus the Admiralty are getting the duty performed for a sum much below, as before stated, that paid in any respectable merchant steam company. Chief engineers have no increase of pay with service the same as doctors and others. As to assistant-engineers, their names are not at all in the "Navy List," not even those of first assistants: again, they are not allowed *cabins* on board the ships; and with regard to their pay our readers may infer, that if chief engineers are so ill-paid and treated, assistants are not any better off. We are informed that, last year, locomotive drivers were entered into the service and allowed to wear the uniform, and received £2 a month more pay than a third-class chief engineer; but we believe the Admiralty have given them up, and are at present entering *mere lads*, who are to be *taught* their duty by the chief engineers and first assistants:

Second,—Chief engineers in the Navy are only allowed the full-dress uniform of a *carpenter*,—the same coat, with a trifling difference of button; and, with the exception of his own assistants, the chief engineer is the only officer on board who does not wear a sword, yet he ranks nominally with a master:

Third,—Engineers are not allowed to go on half-pay the same as other officers, but are placed on what is called the "Steam Reserve," which means that they must live near some dockyard and report themselves twice a-day:

Fourth,—There is no retirement at all established for engineers.

It will be seen by the above that the grievances of the engineers in the Royal Navy are not light ones, and as their requests are moderate, namely, not so much an increase of pay as to be placed on an equality as to uniform, half-pay, and retirement with those officers with whom they rank, and, in addition, that there should be only one class of chief engineers, with increase of pay according to the length of services. It is notorious that there is a sad want of good sea-going engineers in the Navy, and it will be obvious to our readers to what causes it is to be attributed. We would earnestly draw the attention of the Admiralty authorities to the fact, that the employment of unqualified and unpractised persons in the engine-rooms of our vessels of war, will add a serious item to the annual expenses in the shape of the deterioration of the machinery, and we trust that this department will be so re-modelled as to render it the ambition of every marine engineer in the merchant service to enter the Royal Navy.

SOUTHAMPTON.

(*From our own Correspondent.* 15*th January*, 1855).

Messrs. Wigram have recently launched from their building yard at Northam two gun-boats of the following dimensions:—

Length between perpendiculars	106 ft.
Breadth, extreme	22 ft.
Depth	8 ft.
Tonnage, B. M.	$232\frac{62}{94}$ ft.

Named, *Beaver* and *Whiting*.

The machinery, supplied by Messrs. Penn, has been fitted on board the vessels before launching. The high-pressure engines, nominally

60 H.P., are on the double-trunk principle, and being on one side of the vessel only, their weight is counterbalanced by coal on the opposite side. The feed and bilge pumps are worked direct from trunks, and are furnished with india-rubber valves; the cranks and connecting-rods are counterbalanced by cast-iron weights bolted to cranks, as lately noticed in the engines of the *Royal Charter.* The glands for trunks are packed with cast-iron rings, and these, together with piston packing-rings, have Tuck's patent packing behind them.

Diameter of cylinders	21 in.
Diameter of trunks	11 in.
Effective diameter of cylinders, about	18 in.
Stroke of piston	12 in.
Revolutions per minute, about	250.

Brass screw, 6 ft. diameter × 6 ft. pitch × 9 in. fore and aft length, or 1-8th of pitch.

Pressure of steam in boilers, about 60 lbs. on square inch.

Exhaust steam from engines passes up the funnel, by which the generative power of the boilers is enormously increased.

There are three round tubular boilers, side by side.

Diameter of shell	4 ft. 4 in.
Length of shell, without smoke-box	13 ft. 8 in.
Each boiler has one round furnace: diameter	2 ft. 3 in.
Length of fire-bars	4 ft. 10 in.
Number of iron tubes in each boiler	91.
Diameter of iron tubes outside	2 in.
Length of iron tubes	6 ft. 8 in.

One smoke-box at forward end of boilers unites the three into one chimney, $19\frac{1}{4}$ in. diameter, into which exhaust from engines passes, its orifice in chimney being provided with moveable conical covers of various diameters, so that the amount of rarefaction in chimney from the blast may be varied to suit the qualities of coal used. The chimney has also a small additional blast-pipe, from boilers, by which the draught can be increased when getting up steam; and it is found that when the pressure in boilers rises to about 5 lbs. the benefit of this small pipe begins to be apparent, and increases as the pressure rises. A small furnace, lined with fire-brick, something like a house stove, is placed on top of smoke-box, with its flue leading into chimney, the fire in which is lit when getting up steam, and by heating the air in chimney furnishes the necessary draught for boiler furnaces. This little addition to the ordinary appliances of marine engines is found to be of great assistance, and shortens the time of getting up steam from about two hours to about one hour and a quarter, which, in warlike operations, is of immense importance.

The boilers have no steam-chests, the internal steam-pipe having a narrow slot about $\frac{3}{16}$ in. wide running along its top side, and so, by collecting the steam from every part of boiler at equal velocities, appears to obviate the necesssity of a steam-chest, and we understand that priming is seldom observed at sea.

Each boiler has a separate steam-stop and feed-valve, gauge-glasses, and cocks, and can be used separately or collectively; there are also two safety-valves to each boiler.

The funnel and waste steam-pipes are fitted with a hinge a little above the deck, so that they can be laid horizontally when vessels are under sail or in tow of other steamers.

The armament consists of two 8 in. cast-iron guns, and two light brass guns for close quarters. The gunners are defended from Minié bullets by 3-8th in. boiler plate shields, projecting above the rail to about the height of a man for a few feet on each side of gun-port.

Rig—three-masted; sloop; the masts, like funnel, being readily struck.

The speed of this class of gun-boats is about $8\frac{1}{2}$ to 9 knots per hour under steam.

BELGIAN ROYAL MAIL COMPANY'S SCREW STEAM SHIP "BELGIQUE."

THIS vessel, the first of a line of steamers intended to run from Antwerp to New York, calling at Southampton, arrived here on the 31st of December, with leaky boilers.

We understand that after leaving Antwerp the boilers *primed* considerably, and so deceived the engineers as to the real quantity of water in them. The tubes in two boilers being uncovered with water became hot, and by their lateral expansion forced their rivetted ends beyond the tube-plates, and of course leaked so much that the engineer had to draw the fires from the two boilers, and close their stop-valves, and arrived here with the other two boilers only.

The repairs were quickly got through by Messrs. Summers and Day, of Northam, and the vessel sailed on the 6th of January. She put into Plymouth shortly afterwards, and sailed again in a few days. We are sorry to have to record so many mishaps to this vessel, but have no doubt they will be avoided in future.

The engines are nominally of 360 H.P., and are on Messrs. Penn's well-known double-trunk direct-action principle. They were constructed by M. Plissenger, of Amsterdam (by whom the vessel also was built), and appear to be a well-made pair of engines.

Diameter of cylinders	$59\frac{1}{4}$ in.
Diameter of trunks	24 in.
Diameter of cylinder (effective) about	$54\frac{1}{4}$ in.
Stroke of piston	35 in.
Diameter of gudgeon in trunk, for connecting-rod	$5\frac{1}{2}$ in.
Length of bearing of ditto	7 in.
One double-acting air-pump to each engine.	
Diameter of air-pumps	15 in.
Stroke same as piston.	
Revolutions, per minute, about	55.
Pressure of steam	15 lbs.
2 blade screw, diameter	15 ft. 6 in.
Pitch	22 ft.

Vessel is about 1,800 tons B.M. Barque-rigged. Her crew is composed chiefly of Belgians.

PADDLE-YACHT FOR HIS HIGHNESS MUSTAPHA PACHA.

A very beautiful little yacht, for the Nile, has lately been completed by Messrs. Summers and Day, and which is expected to leave for Alexandria about the 17th or 18th inst. She is of iron, and of the following dimensions:—

Length between perpendiculars	145 ft.
Breadth of beam	17 ft.
Depth, floors to deck	7 ft. 6 in.
Tonnage, B.M.	$207\frac{20}{94}$.

Rig—2 pole masts, with light sails, to steady the vessel on her voyage out.

Fore-cabin, fitted with scarlet velvet cushions, &c., in bird's-eye maple panelling.

Saloon, green and gold, magnificent piano by Collard. Ebony chairs, inlaid with mother-o'-pearl, &c.

Private saloon, white and gold, with very chaste fittings.

A pair of single trunk engines.	
Diameter of cylinders	$36\frac{1}{4}$ in.
Diameter of trunks	20 in.
Diameter of cylinders, effective	$33\frac{3}{8}$ in.
Stroke of piston	2 ft. 4 in.
1 single-acting air-pump, diameter	$23\frac{1}{2}$ in.
Stroke	14 in.
Feathering paddle-wheels, diameter over floats	14 ft. 6 in.
Number of floats in each wheel	10.
Size of each	7 ft. × 2 ft.
Dip of ditto	2 ft. 2 in.
Revolutions on trial	38.
Speed of vessel	$14\frac{1}{2}$ mi. per hour.
Pressure of steam in boilers	20 lbs.
Indicated H.P.	250.
1 boiler, with Lamb and Summer's patent flues.	
2 round furnaces, diameter	3 ft. 10 in.

Length of fire-bars	7 ft. 6 in.
Number of flues	16.
Length	6 ft. 6 in.
Depth	4 ft.

The Australian Colonial War Steam Sloop "Victoria," is still in our inner dock. On her passage from London, her screw, which was arranged for varying the pitch, got so much out of order, that it was found uecessary to remove it. We understand she is to be fitted with a common two-bladed brass screw.

AMERICAN NOTES, 1856.—No. II.

STEAM NAVIGATION.

Steamer Vanderbilt, of Vanderbilt's European Line.—This vessel was lauuched on Monday, the 17th inst. (Dec.), and then taken out of the water, by the New York Balance Dock Company's dock, at the foot of Market-street, and has been coppered in twelve working hours after she was taken up. Her dimensions are as follows:—

Hull.—Extreme length, 335 ft.; at the load line, 328 ft. Breadth of beam, 49 ft.; depth of hold, 33 ft. Is 5,100 tons carpenters' measurement, or about 4,000 tons register.

Machinery. — Two cylinders, estimated at about 1,700 H.P.; the cylinder will be 90 in. diameter, by 12 ft. stroke of piston. There will be four tubular boilers, 28 ft. in length, 13 ft. in width, and 14 ft. high, and weighing 60 tons each. Wheels are to be 41 ft. in diameter, and 11 ft. face.

New Line of Steamers between New York and Antwerp.—A new line of ocean steamers has recently been projected, by the Belgian Government, to ply between Antwerp and New York. Four propellers are in the course of completion, as we learn from the agent in this city, Mr. Belmont, the first of which (the *Belgique*) will be dispatched from Antwerp on the 21st. Dec. The others will follow at stated intervals. Notwithstanding the ostentatious manner in which this line has been organised and completed, there is no reasou to doubt its ultimate success. The Rothschild's, we understand, have advanced a considerable sum for the estahlishment of the line, for which the Belgian Government has stipulated to pay an annual interest. These steamers, we are informed, are especially adapted to the transportation of passengers aud freight. As a matter of interest to our mercantile friends, we annex the dimensions of the *Belgique;* the other vessels are to be of the same size and model:—Register, 2,000 tons; H.P., 600; length over all, 295 ft.; breadth of beam, 38 ft.; depth of hold, 29 ft.; draught of water, 18½ ft. forward, and 21 ft. aft. Carrying capacity: 600 tons coal, 550 tons heavy goods, or 700 tons measurement; 40 first, and 100 second-class passengers, and 400 steerage passengers. The space occupied by the steerage passengers may be made available for freight, and in that case 1,100 or 1,200 tons assorted cargo may he taken. The *Belgique* was built at the Fabrique Royale de Machines of Paul Van Vlissingen and Dudok Van Heel, at Amsterdam, and has trunk engines (Penn's system).

Another Oceanic Steam Line.—I have to record another reduction of time and distance between this and a foreign port. An enterprise is just undertaken by the house of S. De Agreda, Jove, and Co., of South-street, which opens a direct communication with the Venezuelan Republic. The steamer *Tennessee*, of 1,200 tons burthen, has been purchased, aud is to sail early in January, as a pioneer upon this line. Its terminus is Porto Cabello, touching at St. Thomas, Porto Rico, and Laguayra, and will leave this port monthly. It is needless to add that the mercantile community will gladly welcome this enterprise. This steamer will accommodate 100 passengers in the usual style of our ocean steamers, and will be an inducement to those who are weary of a visit to "the Continent" to change scene and climate.

DIMENSIONS OF STEAMER "AMERICA."

Built by William H. Webb; Engines by Novelty Iron Works, New York.

Length on Deck	170 ft. 0 ins.
Breadth of beam	27 „ 8 „
Depth of hold to spar-deck	12 „ 0 „
Tons	650.

Kind of engines, oscillating; ditto boilers, return flued; diameter of cylinders, 45 in.; length of stroke, 5 ft. 6 in.; diameter of paddle-wheel over boards, 22 ft.; length of boards, 8 ft.; depth of ditto, 1 ft. 8 in.; numher of boilers, 2; length of ditto, 21 ft.; breadth of ditto at furnace, 9 ft. 6 in.; height of ditto, exclusive of steam-chests, 9 ft.; number of furnaces, 3 in each; breadth of ditto, 2 ft. 4½ in. and 2 ft. 11 in.; length of fire-bars, 6 ft.; number of flues, 15; internal diameter of ditto, 9 of 15½ in., 2 of 14½, and 4 of 10 in.; length of ditto, 5 of 15½ in., 1 of 5 ft. 3 in., and 9 are 10 ft.; diameter of chimney, 50 in.; height of ditto, 28 ft.; area of immersed section at load-draft, 205 ft.; load on safety-valve in lbs. per square in., 25; point of cutting off, ½ stroke; heating surface in each boiler, 940 ft.; contents of bunkers in tons, 225; consumption of coals per hour, 1,100 lbs.; date of trial, November, 1855; draft forward, 8 ft. 6 ins.; ditto aft, 8 ft. 4 ins.; average revolutions, 20; weight of engines, 75 tons; ditto boilers, without water, 65,200 tons; frames, moulded, 12 in., sided, 14 in., and 28 in. apart; independeut steam, fire, and bilge pumps, 1; masts, 2; rig, brigantine; intended service, Pacific Ocean. Hull, strapped with diagonal and double laid iron straps, 4 × ½ in. Floors filled in solid.

NAVAL.

Launch of the U.S. Steam Frigate "Rouneke."—At the launching of this vessel, some ten days since, from the Navy-yard at Gosport, Va., a difficulty occurred which has been reputed to be of an irremediable character as to the future use of this vessel for sea-going purposes. It was alleged that in launching, from some unexperienced cause, that she broke many of her deck-beams, carried away knees, and started her bottom planks to an extent that caused her to fill rapidly with water, and that her sinking was alone arrested by the unavoidable circumstance of her grounding at the opposite side of the river, which is very narrow; and to launch a vessel from the Navy-yard, without grounding her, is altogether impracticable.

From what I gather from the *results*, as detailed, no other particulars being furnished, I infer, that to the provisions for launching, that her stem had been "packed" too far forward, and that upon her stern becoming water-borne, that the distance between the two points of suspension, viz., the bow and stern, and the support of her stern, of a vessel of this great length, had caused her to spring to an extent sufficiently great to start her bottom amidship planks, &c., &c.

The following notice from the "Norfolk Argus" of the 22nd iust. (Dec.), thus refers to this subject:—

"This splendid uaval fabric, whose launch we chronicled a few days ago, is now afloat, having been freed from water by the action of her own pumps, and two common ship's pumps, worked by a small engine, which were introduced on board of her. Her own pumps are sufficient to keep her afloat. Upon examination it appears that eleven of her beams are partially sprung or broken nearly amidships, and forward of the main hatch. The leak is in her bottom about five feet above her kelson, and between the fore and main hatches. She was takeu into dock last evening. She is found to have sustained no other damage than that mentioned. The test of accurate measurement shows that she is not "hogged" in the slightest degree—and, what is of great importance, not one of her knees has been discovered to be started. She will, of course, be thoroughly surveyed when in the dock.

The "Niagara."—This steam-frigate is now nearly completed and ready for launching. Some of the city journals here have stated that she would he launched on the 24th inst., but this is a mistake. The caulking is done, and her cradles are ready; but owing to the immense size of the ship, she will require a channel some 35 feet deep, in which to run out into the river, and this has to be dredged out. This work is now going rapidiy forward, and it is expected that it will be completed so as to launch her on the 8th of January—not before. Her machinery is to be erected and fitted complete in four months after she is launched.

At an early date I shall give you full particulars of this vessel, referring to hull, machinery, spars, &c.

MISCELLANEOUS.

British and American Currency.—As your Government has taken up the subject of an alteration in its denominations of currency and weights, and as any change is opposed by a great many who seem to be so wedded to the existing system as to preclude the possibility of any change, I am desirous of placing before them, in contrast, the operation of their system and that of a decimal one, in a case that is one of constant occurrence.

Thus—What is the cost of an article weighing 7 cwt. 3 qrs. and 21 lbs. at £2 16s. 8d. per qr.?

British method—

cwt.	qrs.	lbs.
7	3	21
4		
31 qrs. and 21 lbs.		

£	s.	d.
2	16	8
		3
8	10	0
		10
85	0	0
2	16	8
£87	16	8

	£	s.	d.
If 28 lbs. cost	2	16	8
Then 14 lbs. is ½	1	8	4
And 7 lbs. ½ of 14	0	14	2
	2	2	6
	87	16	8
	£89	19	2

Total—3 operations, 83 figures and signs, and the result of 47 mental calculations, in order to obtain these figures.

U. S. method (decimal)—The 7 cwt. 3 qrs. and 21 lbs. would be given as 889 lbs. and the £2 16s. 8d. per qr. (at 4·92 dols. per pound) would he 49·78½. dols. Then—

49·78½
889

44,802
398,24
398,24
445

Dols. 442,58·87

Total—1 operation, 45 figures and signs, and the result of 22 mental calculations, to obtain these figures.

This product, at 4·92 dols. for the pound, will give £89 19s. 2d., which is the same result as by the preceding operation.

How to set Timber Posts.—An experienced millwright of this country says, in repairing old mills, he has found it invariably the case that timbers planted with the abut end of the log up, were almost as sound as when put in, while timbers planted with the abut down, although out of the same lot of trees, and subject to precisely the same influences, were so rotten as to resemble a honey-comb.

H.

D. S. HOWARD'S IMPROVED DREDGING MACHINERY.

In The Artizan for September last we gave, amongst the Notes from our American Correspondent, at pp. 209, 210, a very full description of Mr. Howard's Dredging Machinery, and, by request of many of our readers, we now present them with a Plate of the machinery, which will enable the whole to be more readily understood, as, on reference to the Plate and the text in the September Number, nothing further is necessary but to explain some of the parts of the machine shown in the accompanying Plate, which we now proceed to do. The same letters refer to like parts in both views.

In the side elevation the general arrangement of the driving machinery, the bucket-gear, and raising and lowering apparatus is shown; and in the end view the connexions between the two sets of buckets and their apparatus are exhibited.

The steam-boiler, A, is shown in dotted lines; B, being the safety-valve; C, the steam-pipe; D, the exhaust-pipe, rising from the horizontal steam-cylinder, E; F, being the connecting-rod, and G, the crank; H, H, are the driving-pinions; I, I, the driving-chains; J, J, the driving-wheels; K, K, the chain-wheels, or whelp-wheels; L, L, &c., the buckets; M, a flanch-wheel; N, the delivery-shoot; O and P, are for working the latch; Q, the lower chain-wheel; R, the ways; S, the rack-arm; T, U, V, relate to the windlass; W, the chimney; X, the inclined plane; Y and Z are balance-weights and levers.

The parts referred to by the smaller letters of reference do not require special description, as their uses will be readily understood; *a*, spur-wheel; *b*, pawl-arm; *c*, crank; *d*, feed connecting-rod; *e*, main shaft; *f*, driving-shaft; *g*, cable for kedge-anchor; *h*, anchor; *i*, lever; *j*, driving-wheel; *k*, block and sheeves; *l*, chain-wheel; *m*, sheeves; *n*, anchor-hoistings; o, anchor-rope; *p*, capstan; *q*, anchor; *r*, connecting-link; *s*, chain-wheel; *t*, bucket-chain; *u*, car-windlass; *v*, feed motion crank; *w*, pinion; *x*, eccentric; *y*, pawl feed-motion; *z*, hatch.

RECENT ENGLISH PATENTS.

Equilibrium Pressure Gauge (Mr. T. Ricketts, *Watling Works, Stony Stratford*).—The principle of this gauge is that a small piston, exposed to a pressure of steam or water, is connected with and counterbalanced by a comparatively large piston, acted upon by a proportionately small pressure produced by a column of mercury; the fluid pressing upon the small piston, forces up the mercury covering the

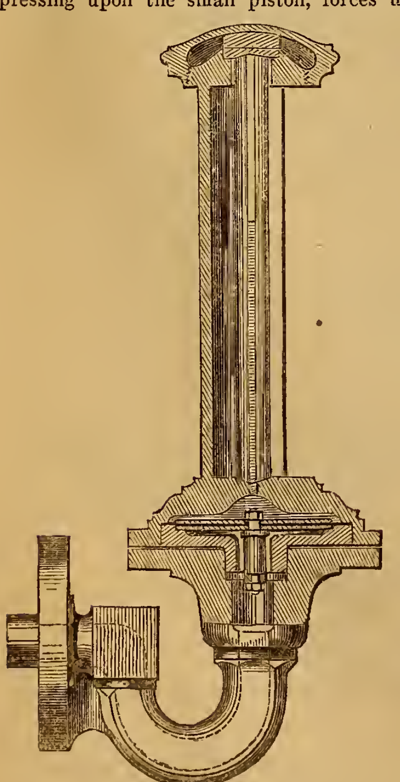


Fig. 1.

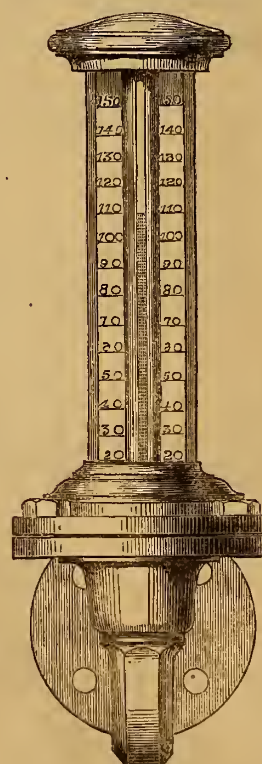


Fig. 2.

larger piston, until it rises to a sufficient height to produce an equilibrium of pressure.

The construction of these pistons (as will be seen from the engravings) is such that they may be said to work frictionless, as they have no bearing or rubbing surface, but are made considerably less than their cylinders, and the joint or hinge forming the connexion between the cylinders and piston is made by a diaphragm or ring of canvas, india rubber, or other flexible material, and as the whole motion of these pistons only amounts to the 140th part of an inch to produce the full pressure of 150 lbs., no perceptible strain is put upon the flexible material; in fact, so perfectly free is the action of this gauge, that a reduction of pressure by each stroke of the engine has frequently been observed in the index.

The gauge is made of cast-iron, and the pistons of wrought-iron, as these metals are not affected by mercury. A glass tube is connected with the upper cylinder in which the mercury rises, and the index-plate adjoining it is graduated from simple calculation tested by actual experiment; a short syphon-tube is cast with the base of the gauge, to protect it from any extreme temperature, which is found to keep it perfectly cool, even in locomotives working with steam at 350°.

The advantages of this gauge are obvious, as, depending simply upon an equilibrium of pressure and not upon the elasticity of steel springs or other material, it is almost impossible that they should ever vary or be subject to the too frequent complaint, in others, of having "permanent set," while, from its being based on simple mechanical principles, its gradnations can be predicated, so that it may always be relied upon as a standard gauge; its extreme simplicity, from there being no working parts, renders it not liable to get out of repair, and enables the manufacturer to offer it at a very moderate price.

Many of these gauges have been at work for several months on stationary, portable, and, latterly, on locomotive engines, and are all, without exception, in as perfect working order as on the first day they were applied.

James Wright, *of Manchester, for Improvements in machinery or apparatus for "curing" and "liquoring" sugar by centrifugal force,—being a communication.*—[Dated 11th March, 1854.]

This invention relates to certain improved dispositions of the parts of the apparatus; as also in the position of the materials treated, by which the inventor's still undeniable advantages are obtained over centrifugal machines hitherto used.

Fig. 1 represents an elevation of the improved machine, having part of the casing removed to show the drainer and exhaust valves or tubes. The outer case or jacket (which is of thin boiler-plate iron, and represented at *c*, *c*) is attached to the curb or upper flanged part of the drainer, *b*, *b*, then carried down about 8 in. lower than the bottom of the drainer, *c*, *c*, *d*, *d*, and rivetted to a bottom of its own, *f*, *f*,—thus leaving a space between the two bottoms amply sufficient to contain all the molasses from a charge in a machine of ordinary dimensions—say 33 in. diameter by 15 in. deep. A space of 6 in. between the side or wall of the jacket and the drainer is left, to allow a sufficient separation between the molasses and the sugar; so that when the machine is stopped, and the molasses settled down into the receptacle at the bottom, there may be no danger of contact. In order to obtain the vacuum referred to, two pipes are inserted into the bottom of the case, through stuffing-boxes with trumpet-shaped or flanged elbows, shown at *g*, *h*. These elbow-pipes move freely up or down in the stuffing-boxes. When pushed up, their ends will project above the molasses in the receptacle, so that none can run out,—but when pulled down, the molasses will flow into and through them, and so be discharged from the machine. The flanged orifices of these pipes revolving rapidly with the motion of the machine will leave a vacuum behind them in their course, into which, of necessity, the air from between the drainer and the jacket must pass,—thus producing a partial vacuum. As a diaphragm for the drainer, the following arrangement is preferable.—First, a perforated sheet of metal is employed, with perforations one quarter of an inch in diameter, and as close together as possible; second, a sheet of coarse copper wire-cloth, the meshes 1-16th of an inch in size; third, a sheet of fine wire-gauze of brass or copper: this last is to come into immediate contact with the sugar. The coarse wire-gauze prevents the finer tissue from being pressed against the metal and its operation impeded, which is the only purpose served by the second layer of wire-cloth. Without this coarser medium, the gauze would cling too closely to the perforated plate, and part of it be thus rendered ineffectual. This machine may be mounted upon a shaft or spindle, so as to revolve with the least friction upon its bearings,—or it may be set upon a stationary spindle, as in the American system; but this is left to the discretion of the workman. The operation of this machine in liquoring refined sugar will alone require to be described—its action with regard to raw sugars being identical. The operation is as follows:—Suppose the sugar filled into moulds, when sufficiently set to admit of drawing the plugs: instead of this being done, the sugar is "knocked out" green, and crushed to separate the crystals. In this state it is like dough in consistence. More "drips" are added to those already in the sugar, till it assumes the form of a thinnish mortar. 180 lbs. of this is then put into the machine, and the machine started after running at speed (1,000 revolutions per

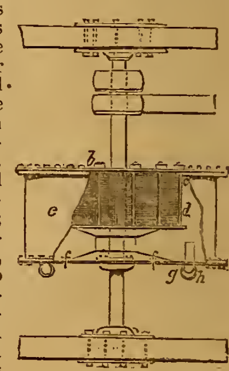


Fig. 1.

minute), say for one minute, or till the sugar appears to have whitened at the surface (this will vary according to the quality): a gallon of liquor is then added, being simply poured slowly into the centre of the machine, out of a gallon measure or other utensil. In five, or at most eight minutes, the operation is complete. If the sugar is required to be very white, another liquor may be necessary. When the machine is to be discharged, the sugar is detached from the sides by a blunt wooden scoop, so as not to injure the wires, and then passed through a hole in the bottom, or lifted out by hand. In this machine two 4-inch tubes may be passed through both bottoms, and the ends flanged out tight. Through these tubes the sugar may be allowed to fall when scraped from the sides, and received into any vessel prepared for it. These orifices may be furnished with piston-stoppers, or be otherwise closed. While the machine is running, the orifices should be at right angles with the exhaust tubes—and being lined with pipe, will in no way affect this action. Sugar liquored in this way is in the form of "moist sugar," but may be pressed into moulds for the production of loaf. A loaf in this way may be produced from the green sugar in ten minutes, ready for the "stove-room;" in the ordinary way, it would require four or five days. Syrups obtained from this machine differ in no respect from those produced by the ordinary slow mode of dripping: in fact they are better adapted for re-boiling, being less exposed to the air during the operation of cloying; and, from properly boiled sugar, 70 per cent. of dry crystal, perfectly white, ought to be obtained, there being no tip to be knocked off. Sugars to be liquored in this way do not require moulds—a wooden cooler being sufficient.

REVIEWS.

The Farmer's Manual of Agricultural Chemistry. By A. Normandy.—Knight and Son.

The author of this little treatise is already well known to the chemical world, both as an original writer and as the translator of "Rose." He has now turned his attention to agriculture, that engrossing topic of all chemical speculators in the present day. His compilation may claim the merit of clearness and simplicity, and is calculated to enlighten rather than bewilder the agricultural mind.

The varieties of soil are classified, and a list is furnished of the spontaneous vegetation peculiar to each. These lists might, in our opinion, be much amended. The blackberry, a native of almost every formation, is mentioned as a characteristic of chalky or calcareous soils, whilst the striking absence of the foxglove on limestone formations is overlooked. The bilberry and cranberry, so plentiful in the sandy soils of Germany, are put down as marks of a humous boggy character.

The ordinary constituents of soils, and their adaptation to peculiar classes of plants are ably explained; all wire-drawn theories as to the origin of ammonia, the source of the nitrogen in vegetables, &c., being avoided. Next follow plain directions for performing the analysis of soils, qualitative and quantitative, with figures of the necessary apparatus and instructions for taking samples. It may, indeed, be questioned whether any mere verbal instructions will ever enable the farmer to analyse his own soils, but it will at least enable him to communicate more satisfactorily with his chemist.

The various kinds of manures, with their immediate and permanent effects upon the soil are next described. The following passage is most important:—

"Hair (containing 13 to 16 per cent. of nitrogen) spread upon meadows is said to augment the crop threefold, and the Chinese are so well aware of the very great value of that manure, that they carefully collect the hair every time they have their heads shaved. Now the crop of hair which every individual leaves at the haircutter's yearly amounts to about half a pound. We have, therefore, a production of about 3,000 tons of hair, which represents at least 15,000 tons of ordinary farm-yard manure, which is, I believe, invariably swept away in our streets or sewers and utterly wasted."

The adulterations to which manures are subject are likewise indicated. A valuable and interesting chapter on the diseases of cereals is succeeded by a notice of predatory insects, the cockchafer, wire-worm, &c. The large common tipula, or daddy-long-legs, a most destructive creature, especially in reclaimed bog-lands, is omitted.

Generally speaking, we can conscientiously recommend this little work to that important section of the community, for whose use it is more especially intended.

Dr. Muspratt's Applied Chemistry.

(Continued from page 16.)

Citric Acid, otherwise called salt of lemon, is a very important article on account of its applications in the art of calico-printing, as well as in the concoction of summer beverages, where, however, it is rarely found in a state of purity. Its sources are the lemon, the lime, and the red currant, especially the former. A cheaper source would be highly desirable. Like other substances employed in the arts, it is subject to adulteration, tartaric acid being often substituted for the genuine article. The high price of the latter, however, consequent on the vine-blight, will, ere long, render this fraud unprofitable. In the lemon-juice used as an anti-scorbutic at sea, oil of vitriol is often met with—a highly economical substitute.

Citric acid is classed by some toxicologists among poisons, a procedure which certainly must lead ordinary mortals to inquire, with some astonishment, what "poison means." Why, we would ask, do druggists sell oxalic acid under the name "salts of lemon?"

Cobalt affords us, in its history, a fine instance how the bugbear of one century may become the coveted object of the next. No long time ago the miner, in seeking for copper, cast aside contemptuously the ores of cobalt, and called them "hobgoblins," mar-works, which excited their hopes but to deceive. And now, what landowner would not execute the wildest capers for joy, if he could but find a vein of cobalt on his property?

As a metal cobalt is of no practical value, and, therefore, is confined to the laboratory of the experimentalist. The more important are its compounds—glass, porcelain, and earthenware—all coloured blue by its aid. Thenards' blue, a composition of cobalt, rivals ultramarine in purity and richness of hue. The "smalt" used in blueing paper, linen, &c., is derived from the same source; and, lastly, sympathetic inks are obtained from the nitrate and chloride. The annual consumption of smalt in England may be stated at 156,000 lbs.

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BRITISH ALMANACK for 1856. Sewed, 1s. With Companion, cloth, 4s. (Knight.)
BURNELL'S Rudimentary Treatise on Limes, &c. 2nd edition, 1s. (Weale.)
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LEICESTER Literary and Philosophical Society.—Reports for 1855, and a Selection of Papers read before the Society since its formation. 8vo (Leicester), pp. 379, cloth, 5s. (Hamilton.)
MUSEUM (The) of Science and Art. Edited by Dionysius Lardner, D.C.L. Vol. 8, 12mo, pp. 208, boards, 1s. 6d. (Walton.)
NOAD (H. M.)—A Manual of Electricity; including Galvanism, Magnetism, Diamagnetism, Electro-Dynamics, Magneto-Electricity, and the Electric Telegraph. By Henry M. Noad. 4th edition, entirely re-written. Part. 1.—Electricity and Galvanism. 8vo, pp. 530, cloth, 16s. (G. Knight.)
WILSON (G.)—What is Technology? an Inaugural Lecture delivered in the University of Edinburgh, Nov. 7, 1855. By George Wilson. 8vo (Edinburgh), pp. 20, sewed, 6d. (Simpkin.)
ARAGO (M.)—Popular Lessons on Astronomy. By the late M. Arago. Translated, with Notes, by Walter Kelly. 6th edition, revised by the Rev. L. Tomlinson. 12mo, pp. 216, cloth, 2s. (Routledge.)
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ON THE COMMERCIAL ECONOMY OF WORKING STEAM EXPANSIVELY IN MARINE ENGINES.*

By Mr. Edward E. Allen, of London.

In the paper read at the last meeting (see Proceedings Inst. M.E., April, 1855†) the author endeavoured to trace out the effects which would result from working steam more expansively than is usual in marine engines. These effects were considered with respect to the increased weight of the engines, and space occupied by them, and the increased capital required; and also with respect to the saving in weight and cost of coals, and increase of cargo-space occasioned by a less quantity of coals being used for any given voyage.

The various calculations were based on the supposition that the usual practice is to cut off the steam at 3-4ths of the stroke; and the cylinders were supposed to be increased in capacity to 1½, 2, 2½, and 3 times successively, in order to effect greater expansion.

By doubling the capacity of the cylinders, it would be found that the steam must be cut off at about 1-4th of the stroke; and by increasing them to 3 times, it must be cut off at about 1-7th of the stroke, in order that the actual power developed may in all cases be the same, and the economy would arise simply from the steam being more expanded in the larger cylinders proposed to be substituted for those ordinarily in use. The pressure of the steam was supposed the same in each case; and the quantity of coal, presumed to be used by marine engines, was based on the supposition that steam of about 20 lbs. pressure per square inch above the atmosphere was employed.

In accordance with the wish expressed at the last meeting, the author now proposes to consider the question of economy arising under different circumstances, namely, an increase in the pressure of the steam employed. There are several ways in which economy may be obtained:—1st, by working steam of the ordinary pressure more expansively than usual; this being the mode of economising pointed out in the paper read at the last meeting: 2nd, by using steam of a higher pressure and expanding to the same extent, or in the same degree, as is now usually the case, namely, about 1⅓ time, or cutting off at 3-4ths of the stroke: and 3rd, by using steam of a higher pressure, and allowing it to expand much more than is now usually the case, or down to, say, 5 lbs per square inch above a vacuum, as a practical limit.

Thus economy would arise simply from using steam of a higher pressure, but still greater economy would result from allowing such high-pressure steam to expand fully. To render this matter clear, it will be necessary to refer to a Table given in the paper read at the last meeting:—

Spaces occupied by steam ..	1	2	3	4	5	6	7	8	9	10
Power developed	1	1·7	2·1	2·4	2·6	2·8	3·0	3·1	3·2	3·3

The quantity of steam being the same in all cases, but allowed to expand so as to occupy the increased spaces.

In this Table no allowance is made either for back-pressure, or for a reduction of power owing to a reduction of temperature while expanding, which, if taken into account would rather reduce the amounts given. With this exception, however, the ratios of power gained by expansion, as shown in the Table, may be considered as correct for all pressures of steam, or, in other words, the same relative advantage would follow from expanding 1 cubic ft. of steam into 3 cubic ft., whether the pressure were 15 lbs. or 120 lbs. on the square inch, the gain from expansion alone being in the ratio of about 2 to 1.

The high-pressure steam would, however, be more economical than the low-pressure, as will be seen from the following Table XIX., which gives the power developed, and the volumes of steam at various pressures formed from the same volume of water, and consequently from the combustion of the same quantity of fuel. The fourth column gives the ratios of power developed, when the steam is used *without expansion*, a back pressure of 2 lbs. being deducted. The fifth column gives the ratios of power developed when the steam is expanded down to 5 lbs. per square inch above a vacuum, and a back-pressure of 2 lbs. deducted; and the sixth column gives the part of the stroke at which the steam must be cut off, so as to expand down to 5 lbs. Column 7 gives the consumption of fuel required to develop the same power, ordinary practice being taken at 100; and column 8 the per-centage saving of fuel, deduced from column 7. The last column gives the ratios of the capacity of cylinder required in each case to develop the same power, and to allow of expansion down to 5 lbs., the ratios being calculated from the size of the cylinder required for 35 lbs. steam, cut off at 3-4ths, which is taken as 1.

Table XIX.

Table showing the power developed and the volume of steam at different pressures, produced from the same volume of water, and consequently with the same consumption of fuel.

Total pressure (including atmosphere) in lbs. per square inch.	Volume of water.	Volume of steam.	Steam *not* expanded, but back-pressure of 2 lbs. deducted. Ratio of power developed, compared with ordinary practice. *	Steam expanded down to 5 lbs. pressure, and back-pressure of 2 lbs. deducted. Ratio of power developed, compared with ordinary practice. *	Part of stroke at which steam must be cut off to expand to 5 lbs.	Consumption of fuel for the same power, in per-centage of ordinary consumption.	Per-centage saving of fuel for the same power.	Capacity of cylinder required for the same power. **
						Percent.	Percent.	
15	1	1669	·66	1·24	1-2·7th	80	20	3½
20	1	1281	·71	1·46	1-3·5	68	32	3
25	1	1044	·74	1·64	1-4·3	61	39	2¾
30	1	883	·76	1·78	1-5	56	44	2½
35	1	767	·78	1·91	1-6	52	48	2⅜
40	1	679	·80	2·02	1-6·6	49	51	2¼
50	1	554	·82	2·22	1-8	45	55	2
60	1	470	·83	2·37	1-10	42	58	1⅞
70	1	400	·84	2·50	1-11	40	60	1¾
80	1	353	·85	2·62	1-12·6	38	62	1¾
90	1	316	·86	2·66	1-14	37	63	1⅝
100	1	287	·87	2·83	1-15·6	35	65	1⅝
110	1	266	·89	2·91	1-17	34	66	1½
120	1	250	·92	3·00	1-18	33	67	1½

Allowance is made in this Table for the reduction of pressure arising from a reduction of temperature during expansion, and the difference this makes may be understood by seeing, from the Table, that steam of 120 lbs. pressure, expanded 18 *times* only, reduces the pressure to 5 lbs. per square inch; whereas if no reduction of pressure took place from a reduction of temperature during expansion, steam of 120 lbs. would have to be expanded 24 *times* (instead of 18 times as above) to reduce it to 5 lbs. pressure.

The Table also shows how the ordinary practice may be improved upon; for example, by using steam of 120 lbs. pressure, and cutting off at 1-18th of the stroke, in which case 3 times the power will be developed from the same combustion of fuel.

As the final pressure is here supposed to be 5 lbs. in all cases, it follows that

* Paper read before the Institution of Mechanical Engineers, Birmingham, July 25, 1855.

† Reported in The Artizan, Vol. xiii., pp. 240, 261, 289.

* Ordinary practice is assumed at 35 lbs. total pressure, cut off at 3-4ths of the stroke, the power developed being called 1.

** The size or capacity of cylinder in ordinary use, *i.e.*, for 35 lbs., steam cut off at 3-4ths, is taken as 1.

the size or capacity of cylinder required is in all cases the same, namely, about 4,500 times the bulk of water evaporated. In ordinary practice the capacity of cylinder may be taken at about 1,000 times the bulk of water evaporated; so that with 120 lbs. steam, cut off at 1-18th of the stroke, although 3 times the power is obtained by the same combustion of fuel, yet the capacity of the cylinder must be about $4\frac{1}{2}$ times that required for steam at 35 lbs., and cut off at 3-4ths. It follows from this, that the *same* power would be developed in a cylinder $1\frac{1}{2}$ times the ordinary size.

In like manner, with steam of 50 lbs. total pressure expanded to 5 lbs. (2 lbs. back-pressure allowed), the steam would require to be cut off at about 1-8th of the stroke; and in order to develop the same power as in ordinary practice, namely, 35 lbs. cut off at 3-4ths, the capacity of the cylinder must be just doubled.

The amount of economy obtained by using steam at increased pressures may be found from column 5. For instance, steam at 50 lbs. pressure, cut off at 1-8th, gives 2·22 times the power obtained in ordinary practice (that is, with 35 lbs. steam, cut off at 3-4ths); and in like manner, steam of 120 lbs., cut off at 1-18th, gives 3 times the power; so that the *same* power is obtained by the combustion of 45 and 33 per cent. of the fuel, or, in other words, the saving in these cases is about 55 and 67 per cent. respectively.

In comparing this ecouomy, due to the use of high-pressure steam, with that shown in the former paper to result from the greater expansion alone of steam of 35 lbs. total pressure, the difference is very marked; for in the latter case, increasing the size of cylinder to $1\frac{1}{2}$ times, the economy was only 19 per cent., whereas, with the same increase in size of cylinder and 120 lbs. steam, the saving is 67 per cent., or $3\frac{1}{2}$ times as great. Again, doubling the size of cylinder with 35 lbs. steam, the saving was 29 per cent.; whereas, with double the size of cylinder and 50 lbs. steam, the saving is 55 per ceut., or nearly double.

It would occupy too much space to pursue the investigation so far as to exhibit at full length the economy resulting from employing steam of *increased pressure* in cylinders of the *increased sizes* assumed in the previous paper; but the cases may be considered in which the size or nominal H.P. of the engines is increased to 1, 2, and 3 times, the intermediate sizes being omitted.

The comparative results are given in the following:—

TABLE XX.

Table showing the relative economy of obtaining the same power by using steam of increased pressure, and by increasing the size or nominal H.P. *of the engines from* 1 *to* 2 *and* 3 *times (the intermediate sizes being omitted). Back-pressure allowed of* $3\frac{1}{2}$ *lbs.*

Total pressure of steam in lbs. per square inch.	Ratio of size of nominal H.P. of engines. 1			2			3		
	Cut off at	Final pressure in lbs. per sq. inch.	Ratio of coal consumed.	Cut off at	Final pressure in lbs. per sq. inch.	Ratio of coal consumed.	Cut off at	Final pressure in lbs. per sq. inch.	Ratio of coal consumed.
35	3-4th	$25\frac{1}{2}$	100	1-4th	$7\frac{1}{2}$	66	1-7th	$4\frac{1}{2}$	57
40	2-5	$14\frac{1}{2}$	68	1-6	$5\frac{3}{4}$	57	1-10	$3\frac{1}{2}$	51
50	1-3·3	$13\frac{1}{2}$	58	1-8	5	48	1-13	3	45
60	1-4	13	53	1-9·5	$4\frac{7}{8}$	45	1-15	3	42
70	1-5	12	48	1-12	$4\frac{3}{4}$	41	1-18	3	39
80	1-6·6	10	43	1-15	$4\frac{3}{8}$	38	..	..	..
90	1-8	$9\frac{1}{4}$	40	1-18	4	36	..	..	..
100	1-10	$8\frac{1}{4}$	38	1-22	$3\frac{3}{4}$	35	..	..	..
110	1-11	8	37	1-24	$3\frac{5}{8}$	34	..	..	..
120	1-12	$7\frac{3}{4}$	35	1-26	$3\frac{1}{2}$	32	..	..	..

From this Table it appears that a choice may he frequently made between two ways of employing steam, both resulting in the same economy, so far as the consumption of coal is concerned. For instance, steam at 50 lbs., cut off at 3-10ths, and steam at 35 lbs., cut off at 1-7th, give the same results, or nearly so; but the low-pressure steam requires a cylinder of 3 times the capacity of the other.

Again, steam at 70 lbs., cut off at 1-5th, and steam at 50 lbs., cut off at 1-8th, give the same results; but the low-pressure steam requires a cylinder of double the capacity of the other.

The results have not been carried out in the third series of columns for pressures above 70 lbs., as the final pressures fall too far below the assumed back-pressure.

The consideration of the subject will now be confined to the economy that would be effected by using steam of *increased pressure* in a cylinder of the *ordinary size*.

The following Table XXI. has been compiled in order to show with what economy steam of increased pressure can be expanded in a cylinder of the ordinary size so as to develop the same power.

The pressures begin at 35 lbs., cut off at 3-4ths, which is assumed as the ordinary practice, and the power developed under these conditions is called 1. Column 1 gives the total pressures; column 2 the part of the stroke at which the steam must be cut off in each case to develop the same power; column 3 the ratio of the power developed by the same consumption of coal; column 4 the relative quantities of coal required to develop the same power; column 5 the per-centage saving of coal; and column 6 the final pressure of the steam on its exit from the cylinder.

From this Table it will be seen that in the case of an engine working with 35 lbs. steam and cutting off at 3-4ths of the stroke, if it be required to increase the pressure (in order to economise) to say 70 lbs., then the steam must be cut off at about 1-5th of the stroke, and the consumptiou of coal will be only 48 per cent. of the quantity previously cousumed, the power developed remaining the same. So, also, if the pressure be increased to 120 lbs., the steam must be cut off at about 1-12th of the stroke, and the consumption will be reduced to 35 per cent., the same power being developed. The size of the cylinder remains the same in all cases.

With respect to the weight of machinery, it will not make much difference to what pressure the steam is raised; for although the weights slightly decrease when high-pressure steam is used, yet the difference is very little, and not worth considering in the present investigation.

TABLE XXI.

Table showing the economy of working steam of increased pressure in a cylinder of the ordinary size.

Total pressure of steam in lbs. per square inch.	Part of stroke at which steam is cut off to develop same power.	Ratio of power developed by same consumption of coal.	Ratio of coal required to develop same power.	Saving of coal in per-centage on ordinary consumption.	Final pressure of steam on leaving cylinder, in lbs. per square inch.
				Per Cent.	
35 ·	3-4th	1·00	100	—	$25\frac{1}{2}$
40	2-5	1·47	68	32	$14\frac{1}{2}$
50	1-3·3	1·72	58	42	$13\frac{1}{2}$
60	1-4	1·88	53	47	13
70	1-5	2·06	·48	52	12
80	1-6·6	2·28	43	57	10
90	1-8	2·44	40	60	$9\frac{1}{4}$
100	1-10	2·60	38	62	$8\frac{1}{4}$
110	1-11	2·70	37	63	8
120	1-12	2·80	35	65	$7\frac{3}{4}$

In order to give a more complete view of the difference between the economy resulting from the increased expansion of ordinary steam, and that arising from the increase of pressure of the steam itself, the two following series of Tables, Nos. XXII. and XXIII., have been compiled.

The first series, XXII., is based on the supposition that the size of the engines is increased to $1\frac{1}{2}$, 2, $2\frac{1}{2}$, and 3 times for expansive working; but that from improved machinery and reduction in the weight of boilers (from diminished consumption of fuel), the gross weight of machinery and the space occupied remain constant.

The second series, XXIII., is based on the supposition that the size of the engines remains constant, as well as the gross weight of machinery, and the space occupied; but that the pressure increases from 35 lbs. to 60, 80, 100, and 120 lbs.

TABLE XXII.—SECTION A.

Table showing the weights of machinery and coal, and joint weights of same; the size or nominal H.P. *increasing from* 1 *to* 3, *the indicated* H.P. *remaining the same.*

Class.	Service.	Ratio of size or nominal H.P.	Gross weight of machinery constant.*	Ratio of weight of coal corresponding to increased nominal H.P.	Ratio of total weights.	Ratio of time the coal would last, if total weights be kept the same.	Ratio in days.
1	River.	1	1	·25	1·25	1·00	$2\frac{1}{2}$
		$1\frac{1}{2}$	1	·20	1·20	1·23	3
		2	1	·18	1·18	1·40	$3\frac{1}{2}$
		$2\frac{1}{2}$	1	·16	1·16	1·58	4
		3	1	·14	1·14	1·75	$4\frac{1}{4}$
2	Coasting and Continental.	1	1	1·00	2·00	1·00	10
		$1\frac{1}{2}$	1	·81	1·81	1·23	$12\frac{1}{4}$
		2	1	·71	1·71	1·40	14
		$2\frac{1}{2}$	1	·63	1·63	1·58	$15\frac{3}{4}$
		3	1	·57	1·57	1·75	$17\frac{1}{2}$
3	Ocean (short voyages) aud Government.	1	1	1·50	2·50	1·00	15
		$1\frac{1}{2}$	1	1·21	2·21	1·23	$18\frac{1}{2}$
		2	1	1·06	2·06	1·40	21
		$2\frac{1}{2}$	1	·94	1·94	1·58	$23\frac{3}{4}$
		3	1	·85	1·85	1·75	$26\frac{1}{4}$
4	Ocean (long voyages), Australian.	1	1	4·00	5·00	1·00	40
		$1\frac{1}{2}$	1	3·24	4·24	1·23	$49\frac{1}{4}$
		2	1	2·84	3·84	1·40	56
		$2\frac{1}{2}$	1	2·52	3·52	1·58	$63\frac{1}{4}$
		3	1	2·28	3·28	1·75	70
5	Ocean (voyage out and home), Eastern Steam Navigation Company.	1	1	7·00	8·00	1·00	70
		$1\frac{1}{2}$	1	5·67	6·67	1·23	86
		2	1	4·97	5·97	1·40	98
		$2\frac{1}{2}$	1	4·41	5·41	1·58	$110\frac{1}{2}$
		3	1	3·99	4·99	1·75	$122\frac{1}{2}$

* Weight of boilers aud water supposed to be reduced, aud weight of engines not increased in higher ratio.

In both series of Tables, XXII. and XXIII.,

Sections A refer to the total weights.
Sections B ,, ,, spaces.
Sections C ,, ,, cargo space.
Sections D give a summary of the preceding sections.

TABLE XXII.—SECTION B.

Table showing the spaces occupied by engines, boilers, and passages together, and by coals; and also the ratio of the total spaces; the size or nominal H.P. *increasing from* 1 *to* 3, *the indicated* H.P. *remaining the same.*

Class.	Service.	Ratio of size or nominal H.P.	Space occupied by engines, boilers, and passages constant.*	Ratio of spaces occupied by coals.	Ratio of total spaces.
1	River.	1	3	1·00	4·00
		1½	3	·81	3·81
		2	3	·71	3·71
		2½	3	·63	3·63
		3	3	·57	3·57
2 and 3	Coasting and Continental, and Ocean (short voyages).	1	3	3·00	6·00
		1½	3	2·43	5·43
		2	3	2·13	5·13
		2½	3	1·89	4·89
		3	3	1·71	4·71
4 and 5	Ocean (long voyages), and voyage out and home.	1	3	5·00	8·00
		1½	3	4·05	7·05
		2	3	3·55	6·55
		2½	3	3·15	6·15
		3	3	2·85	5·85

Tables XXII. show the results of increased expansion of ordinary steam.

Sections A and B show how the total weights of machinery and coals taken together, and also the total spaces occupied by them, decrease from class 1 to 5, on the supposition that the gross weight of machinery and the space occupied by it remain constant.

TABLE XXII.—SECTION C.

Table showing the Gain in CARGO SPACE, *when the space occupied by the engines, boilers, and passages is constant;* the size or nominal* H.P., *increasing from* 1 *to* 3 *the indicated* H.P. *remaining the same.*

Class.	Service.	Ratio of size or nominal H.P.	Ratio of total spaces occupied by machinery and coals, from foregoing table.	The same ratio, but showing the per-centage decrease.	Per-centage gain in cargo-space. 1st. When total machinery and coal space is *equal* to total cargo space.	2nd. When total machinery and coal space is ⅔ of total cargo space.	3rd. When total machinery and coal space is ½ of total cargo space.
					Per cent.	Per cent.	Per cent.
1	River.	1	4·00	100	—	—	—
		1½	3·81	95	5	3⅓	2⅛
		2	3·71	93	7	4⅔	3⅛
		2½	3·63	91	9	6	4½
		3	3·57	89	11	7⅓	5½
2 and 3	Coasting and Continental, and Ocean (short voyages).	1	6·00	100	—	—	—
		1½	5·43	90	10	6⅔	5
		2	5·13	85	15	10	7½
		2½	4·89	81	19	12⅔	9½
		3	4·71	78	22	14⅔	11
4 and 5	Ocean (long voyages), and voyage out and home.	1	8·00	100	—	—	—
		1½	7·05	88	12	8	6
		2	6·55	82	18	12	9
		2½	6·15	77	23	15⅓	11½
		3	5·85	73	27	18	13½

Section C. shows how the cargo-space continually increases from class 1 to 5.

Section D. gives a general summary of the three preceding ones, and shows the per-centage of increase of time the coals would last, if the total weights of machinery and coals taken together were kept the same; and as this depends upon the saving in coal alone, the weight of machinery being supposed constant, it amounts to the same in all the classes; being equal to 40 per cent. if the engines be doubled in size, and 75 per cent. if the engines be increased to three times the size.

TABLE XXII.—SECTION D. GENERAL SUMMARY.

Table compiled from the three foregoing Tables; the cost, weight, and space of engines, boilers, and passages, and water, being constant; the size or nominal H.P. *increasing from* 1 *to* 2 *and* 3 *times (the intermediate sizes being omitted), the indicated* H.P. *remaining the same.*

Class	Service.	Ratio of size or nominal H.P.	Annual saving of coal in per-centage of capital (Table XVIII).	Increase of capital per cent.	Total weight of coal and machinery; decrease per cent. (deduced from column 6, section A).	Total spaces occupied by coal and machinery; decrease per cent. (deduced from column 6, section B).	Cargo-space: increase per cent. 1st. When total machinery and coal-space is *equal* to total cargo-space.	2nd. When total machinery and coal-space is 2-3rds of total cargo-space.	3rd. When total machinery and coal-space is *half* of total cargo-space.	Per-centage of increase of time the coals would last, if total weights be kept the same.	Number of days the coals would last, if total weights be kept the same.	Annual per-centage gain on capital from saving of coal and increase of cargo-space. If the net profits cover cost of vessel in one year.	If the net profits cover cost of vessel in two years.
			Per cent.		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.
1	River	1	....	Capital costant; cost of boilers supposed to be reduced, and cost of engines not increased in higher ratio.	....	....	....	....	....	....	2½	....	....
		2	4·35		5·60	7	7	4⅔	3½	40	3½	9·01	6·68
		3	6·45		8·80	11	11	7⅓	5½	75	4¼	13·78	10·11
2	Coasting and Continental.	1	....		....	....	....	....	....	....	10	....	....
		2	1·45		14·50	15	15	10	7½	40	14	11·45	6·45
		3	2·15		21·50	22	22	14⅔	11	75	17½	16·81	9·48
3	Ocean (short voyages) and Government.	1	....		....	....	....	....	....	....	15	....	....
		2	1·45		17·60	15	15	10	7½	40	21	11·45	6·45
		3	2·15		26·00	22	22	14⅔	11	75	26¼	16·81	9·48
4	Ocean (long voyages) Australian.	1	....		....	....	....	....	....	....	40	....	....
		2	7·25		23·20	18	18	12	9	40	56	19·25	13·25
		3	10·75		34·40	27	27	18	13½	75	70	28·75	19·75
5	Ocean (voyage out and home).	1	....		....	....	....	....	....	....	70	....	....
		2	1·45		25·37	18	18	12	9	40	98	13·45	7·45
		3	2·15		37·62	27	27	18	13½	75	122½	20·15	11·15

The two last columns give the annual per-centage gain on the capital, from saving in coal and gain in cargo-space; firstly, when the net profits cover the cost of vessel in one year, and, secondly, when the net profits cover the cost of vessel in two years; the total machinery and coal-space being taken at 2-3rds of the total cargo-space in each case.

It is only on the supposition that the net profits for a given period cover the cost of vessel or capital, that the gain from increase of cargo-space can be added to the gain from saving in coal. If the vessel be supposed to have cost a sum equal to the net profits of three or any other number of years, then, in order to find the total annual gain, it is only necessary to divide the annual per-centage gain from increase of cargo-space by 3, or any number determined on, and add the quotient to the annual per-centage gain from saving in coal; the sum will be the gross annual per-centage gain on capital.

Tables XXIII. show the results of increase of pressure of the steam itself.

* Space occupied by boilers supposed to be reduced, and space occupied by engines not increased in higher ratio.

* Space occupied by boilers and passages supposed to be reduced, and space occupied by engines not increased in higher ratio.

The use of Section A. may be thus illustrated: taking the 2nd class of steamers, it is seen that if steam of 35 lbs. pressure be used and cut of at 3-4ths, a weight of coal equal to the weight of machinery will last ten days; but if steam of 80 lbs. pressure be used (in the same sized cylinder), then the same power will be developed by a consumption of 43 per cent. of the fuel, the steam being cut off at 3-20ths; and a weight of coal equal to the weight of machinery would last 23 days instead of 10. In like manner, if steam of 120 lbs. pressure be used (also in the same sized cylinder), then the same power will be developed by a consumption of 35 per cent. of the fuel, the steam being cut off at about 1-12th; and a weight of coal equal to the weight of machinery would last 28 days instead of 10. In all the other classes of steamers the same proportions hold good.

TABLE XXIII.—SECTION A.

Table showing the WEIGHTS *of machinery and coal, and joint weights of same; the total pressure increasing from* 35 *to* 60, 80, 100, *and* 120 *lbs. per square inch; the size or nominal* H.P. *of the engines, the indicated* H.P., *and the gross weight of machinery remaining the same.*

Class.	Service.	Total pressure of steam in lbs. per square inch.	Weight of machinery supposed constant.	Ratio of weight of coal corresponding to increased pressure.	Ratio of total weights	Ratio of time the coal would last, if total weights be kept the same.	Ratio in days.
1	River.	35	1	·25	1·25	1·00	$2\frac{1}{2}$
		60	1	·132	1·132	1·88	$4\frac{3}{4}$
		80	1	·109	1·109	2·32	$5\frac{3}{4}$
		100	1	·095	1·095	2·63	$6\frac{1}{2}$
		120	1	·087	1·087	2·85	7
2	Coasting and Continental.	35	1	1·00	2·00	1·00	10
		60	1	·53	1·53	1·88	19
		80	1	·43	1·43	2·32	23
		100	1	·38	1·38	2·63	26
		120	1	·35	1·35	2·85	28
3	Ocean (short voyages) and Government.	35	1	1.50	2·50	1·00	15
		60	1	·795	1·795	1·88	28
		80	1	·645	1·645	2·32	35
		100	1	·570	1·570	2·63	$39\frac{1}{2}$
		120	1	·525	1·525	2 85	$42\frac{3}{4}$
4	Ocean (long voyages) Australian.	35	1	4·00	5·00	1·00	40
		60	1	2·12	3·12	1·88	75
		80	1	1·72	2·72	2·32	93
		100	1	1·52	2·52	2·63	105
		120	1	1·40	2·40	2·85	114
5	Ocean, voyage out and home, Eastern Steam Navigation Company.	35	1	7·00	8·00	1·00	70
		60	1	3·71	4·71	1·88	132
		80	1	3·01	4·01	2·32	162
		100	1	2·66	3·66	2·63	184
		120	1	2·45	3·45	2·85	200

(*To be continued in our next.*)

CIVIL ENGINEERING.

INTER-OCEANIC SHIP CANAL *viâ* THE ATRATO AND TRUANDO RIVERS.*

By EDWARD W. SERRELL, Civ. Eng.

FOR many years attempts have been made by several of the most enlightened governments of the world, and by enterprising individuals, to determine the practicability of connecting the Atlantic and Pacific Oceans *by water*, artificially.

The minds of those who have investigated the subject most closely, and among them the great Humboldt, seem to have rested on three localities—namely, the Isthmuses of Nicaragua and Panama, and the Atrato river.

The latter, probably owing to the considerable breadth of the country, has, until very recently, received but little attention.

During the past four years, however, many very elaborate surveys have been made on its waters and tributaries, and the surrounding country. These examinations have been conducted by Mr. John C. Trautwine, Mr. James C. Lane, and Captain William Kenuish, and the several corps under their directions.

They have been undertaken at the instance of American merchants; the expenses of the last two surveys, and of obtaining the rights to construct the works, have been borne by Mr. Frederick M. Kelley, of New York.

The Atrato is a broad and deep river. For seventy miles from its mouth it has an average depth of 47 ft., and the channel-way for this distance is from 800 ft. to 1,200 ft. in width.

At the mouths of the river, which finds its way into the Gulf of Uraba or Darien by nine bocas or estuaries, there are bars formed from sedimentary deposits, and the water is only 4 ft. or 5 ft. deep.

The bay itself is very ample, and deep enough for the largest vessels.

The line for the contemplated connexion betweeu the oceans ascends the Atrato sixty-three miles; it then enters the valley of a tributary known as the Truando, which is followed for thirty-six miles.

This river is now navigable for vessels drawing 12 ft. of water, for thirty-eight miles from its conflueuce with the Atrato.

From the Atrato, for thirty-six miles, it is intended to deepen and widen the Truando, and then to make an open cut through rock twenty-five miles to the Pacific Ocean.

The cut will average 96 ft. deep, excepting a tunnel three and a quarter miles in length.

It is contemplated to make the prism of the canal 200 ft. wide, and 30 ft. deep, at extreme low tide.

The river Atrato flows at the rate of about two and a half miles per hour, and the point of confluence with the Atrato, as determined by Mr. Kennish, is 15·2 above mean level in the oceans.

On the Pacific there is a rise and fall of the tide, at the outlet, of 12 ft. $\frac{4}{10}$ths. At the mouth of the Atrato, on the Atlantic, there is but 20 in. rise and fall. So that when the cut is complete, the Atrato will have two mouths, oue emptying into the Atlantic, and the other into the Pacific. The passage from ocean to ocean will be up one mouth and down the other.

The currents in these channels will, on the Atlantic side, be varied but little from what it now is, as the head will be reduced but about 1 ft., as determined by the comparison of the sections of the streams and the quantity of supply.

The velocity of the water through the new channel, at high-water in the Pacific, will be equal to that which is due to a head of 14 ft., minus 6 ft. $1\frac{1}{2}$ tenths; and at low tide 14 ft. plus 6·25; so that without reference to the *flow* of the tide *into* and *out of* the cut, which, however, will equilibrate it, the current in mean will be essentially the same as to the Atlantic, excepting that which is due to greater straightness in the new channel.

All the material necessary for constructions upon the line of the work exist in the country, excepting the metals.

An excellent harbour already exists at the Atlantic terminus, and on the Pacific but little labour is required to make the harbour there equal to any for safety and accessibility on the coast.

The distinctive features of this route are, an inter-oceanic connexion, having depth and width sufficient to pass the largest vessels abreast now afloat, and upon which no locks or any other obstructions of any kind will occur, and that there are good harbours at either end.

The country through which the line passes, where the constructions and deepening of the river Truando have to be done, is very healthy and productive.

On the Atrato, the only unhealthy part of the route, there is no work to be done, except at the bars of the mouth, and here the climate is comparatively salubrious from the constant sea breezes.

In making the surveys, very ample notes of the geology, botany, aud sylvia, have been taken; and the sanitary condition of the country at the various locations, together with the meteorological changes, have been noted.

Mr. Serrell has estimated the cost of the work, predicated on the data furnished by Mr. Kennish, at one hundred and forty-seven millions of dollars.

Several of the most eminent engineers in the country have been consulted, and corroborate this estimate.

By the data furnished from Mr. Stoue's commercial statements of the present trade of the world, it has also been estimated that the present business between the two oceaus, that would pass through this canal if now in use, without making allowanee for any increase, would pay 12 per cent. on a cost of two hundred millions of dollars, and then save to itself 6 per cent., or upwards of three hundred and eighty millions of dollars.

It has been estimated that 25,000 men will have to be constantly employed for twelve years to build the work.

This number can be maintained and sustained, as the average haul for supplies from water carriage is only twelve miles, and the location where the work is to be done is healthy.

The Federal Government of the United States proposes to verify the surveys, and France and England have been asked to participate.

The necessary grants and treaties have been perfected by which the route is secured, and a financial plan is now being digested, upon which it is proposed to commence and prosecute the construction of the work vigorously.

* From the "Journal of the Franklin Institute."

BRIDGE FOUNDATIONS.

DESCRIPTION OF THE MODE OF FOUNDING THE PIERS OF THE OHIO AND PENNSYLVANIA RAILROAD BRIDGE ACROSS THE ALLEGHENY RIVER AT PITTSBURGH.*

By SOLOMON W. ROBERTS, Chief Engineer.

THE city of Pittsburgh and the city of Allegheny are separated by the Allegheny river, which is a stream about 1,200 ft. wide, and which sometimes rises to the height of 30 ft. above low water-mark. Such great floods are, however, very rare, but a rise of 12 ft. or 15 ft. is a common occurrence, and the current is then very strong. The bottom of the river, to an unknown depth, consists of a mass of gravel, mixed with bolder stones of the size commonly used for street-paving, and occasionally containing water-worn stones of a much larger size. The depth of the stream at low water is very irregular, and while at some places the gravel bottom will be dry, at others the water will be from 15 ft. to 20 ft. deep.

The river is badly adapted to the construction of coffer-dams, on account of the porous nature of the gravel bottom, through which water readily flows; and because they would be exposed to injury from frequent freshets, even if it was possible to pump the water out of the coffer-dams within any reasonable limits of cost.

In order to make the best connexion between the two railroads, the site selected for the Ohio and Pennsylvania railroad bridge is opposite the passenger station of the Pennsylvania railroad, in Pittsburgh. It also has the advantage of convenient approaches ou both sides of the river, without interfering with any valuable buildings. The bottom of the river at the site of the bridge is, however, very irregular, varying in depth, at low water, from 1 ft. to 14 ft.

After the bottom of the river had been carefully sounded, and a correct cross-section made of it; it was determined to found the piers by excavating the pits for them, by means of a steam-dredging machine working on a boat, and by sinking heavy cribs, or solid masses of large square timber below low water, on which to start the masonry.

This plan has been carried out with entire success, and with very little difficulty. Several of the piers, which are built of very heavy masonry laid in cement, are now approaching completion, and they show no signs of settlement whatever. The work in the river was begun on the 16th of August, 1854, and the foundation of the fifth pier was put in on the 5th of November following, being less than theee months from the commencement of the work. The remaining pier is in shallow water near the shore, and the abutments are both upon dry land. The height of the piers from low water-mark to the under side of the bridge superstructure is 38 ft., and the depth of the timber foundations under two of the piers is 12 ft.

The pits, as excavated by the dredging-machine, varied in depth from 5 ft. to 13 ft. below low water, the object being to obtain a level and uniform foundation. Each pit was about 68 ft. long and 26 ft. wide on the bottom, and the cost of excavating and removing the gravel, by contract, was fifty cents. per cubic yard. By the careful use of the buckets of the dredging-machine, and occasionally of a heavy iron rake the bottoms of the pits were made very smooth and even. One large stone, which could not be removed by the means at hand, was sunk in a hole dug for the purpose alongside of the pit.

The timber foundations were constructed of white pine timber, sawed square, and 1 ft. thick. They were built afloat in the river, the first course of timbers being 24 ft. long, and laid side by side, across the line of the pier. The second course crossed the first at right angles, and was bolted to it with iron rag bolts. The third course, bolted to the second, ran in the same directiou as the first. In this way an exceedingly strong foundation was constructed of solid timber, 3 ft. thick, and large enough to distribute the weight to be supported over an extensive surface, 66 ft. long by 24 ft. wide. The masonry of each pier, at low water-mark, is $14\frac{1}{2}$ ft. thick, and its extreme length is $63\frac{1}{2}$ ft., the ends being semi-circular. The top of the timber foundation is 18 ft. 3 in. broad, and 65 ft. long. After the first three courses of timber were laid, the additional courses were drawn in on the sides, by a succession of stops, so as to reduce the timber work to these dimensions on the top; and the upper course was planked with 3 in. plank on which the masonry was started.

Experience showed that where the water was deep, and the foundations consisted of a good many courses of timber, it was expedient to leave some spaees between the timbers and fill them with stone, so that the whole mass might be but little lighter than an equal bulk of water, in order that the top of the timber foundation might float but little above the water, and be about level with the decks of the flat boats loaded with dressed stone for the pier, which lay on each side of the foundation to steady it. The first course of the pier masonry was thus laid in the most convenient manner, the river being low; and the weight of the stone work sunk the foundation down upon its permanent bed and in its appropriate place. The men were not required to work in the water, and all expense for pumping was avoided.

After the foundations were thus sunk in the manner desired, a large quantity of heavy loose stone, or rip rap, was placed around them, to secure them from the scouring action of the river.

The durability of the timber is secured by its being always under water, and of the permanence of the structure there is no doubt.

* From the "Journal of the Franklin Institute."

ROYAL SCOTTISH SOCIETY OF ARTS.

The Royal Scottish Society of Arts met in their Hall, 51, George-street, on Monday, 14th January, 1856, JAMES ELLIOT, Esq., V.P., in the chair, when the following communications were made:—

1. *On a peculiar Mechanical Imitation of Electro-Magnetic Rotation.* By James Elliot, Esq., V.P., teacher of mathematics. Illustrated by experiments.

In this communication the author first describes the singular phenomena of electro-magnetic revolution, first discovered by Professor Faraday—viz., that each pole of a magnet has a tendency to revolve round an electric current, that the two poles tend to revolve in opposite directions, and that the directions of rotation of each are changed by a change in the direction of the current. He then proceeds to show the difficulty of forming any hypothesis regarding the way in which such revolutions can arise by any known mode of operation common to other departments of physics. The first difficulty arises from the fact that the electric current is wholly confined to the conducting-wire, while its magnetic effects are external to it. This difficulty the author endeavours to show by reference to other phenomena; and, by direct experiment, is not insuperable. But, supposing it to be overcome, another, more formidable, meets us. How can a current in a rectilineal direction produce a revolution in a plane perpendicular to that direction without the agency of rigid mechanism? The only known case resembling it is that of a current of fluid directed upon oblique vanes, free to move only in a plane perpendicular to the direction of the current; but to render the cases strictly parallel, he shows that such a peculiar molecular structure would be necessary in the magnet, and such an incessant change in the position of its atoms during the revolution as to render the hypothesis of any similarity of cause too complicated to be admissible. The author then, after discussing the possibility of several hypothetical modes of operation, proceeded to show, experimentally, that if a magnet be made to rotate on its axis, resting on a fixed point, coincident with its centre of gravity, and if, while so rotating, its pole be brought near either pole of a fixed magnet, the rotating magnet revolves round the fixed magnet, the direction of revolution varying with the relative positions of the poles. When the adjacent poles are of the same name, the direction of the revolution is the same as that of the rotation; but when the adjacent poles are of different names the direction of the revolution is contrary to that of rotation. We have thus a motion precisely resembling electro-magnetic revolution, produced on well-known physical principles. How far there may be any similarity in their causes remains for consideration.—Referred to a committee.

2. Notice regarding Mr. Robert H. Bow's paper on *New Designs for Iron Roofs of Great clear Span.* By Robert Mallet, Esq., C.E., M.I.C.E., Hon. F.R.S.S.A., Delville, Glasnevin, County Dublin. With a tracing.

Mr. Mallet referred in a highly complimentary manner to Mr. Bow's paper, but begged permission to correct the statement that the designs were new, as he himself had made extensive use of such roofs; that they had been previously proposed by Mr. Adams, of London, and, at a still earlier date, were known in France.

3. *On the subject of Mr. Mallet's Letter, with Results of some further Investigations.* By R. H. Bow, Esq., C.E.

Mr. Bow stated that he was not aware of the existence of similar roofs to those proposed by himself, until after the reading of his paper to the Society; that, however, he never took much credit for the mere designs, but put the chief value upon the investigations, which proved the superiority of these over the form of roof most frequently employed for railway stations. He considered Mr. Mallet's letter was very valuable, as giving the history of the leading form of the designs, and thought the extensive adoption of this class of roofs reflected the greatest credit upon Mr. Mallet. Mr. Bow gave results of some further investigations, and stated that these had pointed out to himself the erroneousness of an impression he had entertained,—viz., that the designs were peculiarly suited for *great spans* only, or where many supported points were desirable for the rafters; whereas it was now proved that these roofs were pre-eminently suited for *all* spans. After some discussion, in which the Society considered the correspondence between Messrs. Mallet and Bow highly creditable to both of these gentlemen, from the good spirit shown in it, and a willingness to do each other justice, the papers were referred to the Publication Committee.

4. *Suggestions for increasing the Speed of Steam-boats.* By Robert Aytoun, Esq., W.S.

Mr. Aytoun stated that the well-known proposition in hydraulics, *that the power required to impel a boat increases as the square of the velocity*, has exercised a pernicious influence over the minds of shipbuilders, in making them look upon it as hopeless to attempt any great increase of speed, which was to be attended by such enormous increase of power. This proposition, by showing the impossibility of greatly increasing speed with any of the known forms of boats, by giving them increased power, clearly indicated that the path of improvement, if any, must lie in new forms, calculated to take advantage of the new power of the marine steam-engine. It at once occurred to the author that by elongating the bow of the vessel, that water which our present steam-boats dash aside from their path with great force and velocity, and the rapid removal of which absorbs the whole power of the engine, might be laid aside comparatively slowly and gently, like the sod from a Scotch plough, however great the speed of the vessel. A diagram was here shown, exhibiting three steam-boats, whose midship sections were all equal, but the length of whose bows were respectively 1, 2, and 3. It was pointed out that when No. 2 had twice the speed of No. 1, it dashed aside the water in its path with no greater velocity than did No. 1, and therefore did not require more steam-power, though proceeding at double speed. That when No. 3 had thrice the speed of No. 1, it dashed aside the water in its path with no greater velocity than did No. 1, and therefore did not require more steam-power, though proceeding at three times the speed. It thus appeared that the well-known proposition above referred to, which has so long paralyzed the efforts of shipbuilders, must now give place to the more hopeful one—namely, *that the resistance to the motion of boats may be made the same for all velocities, by suiting the form of the boat to the velocity required of it.* A similar proposition, in regard to railways, was early made by Mr. Maclaren, with the happiest results, at a time when eight or ten miles an hour was the greatest speed they were thought capable of achieving. The author stated that it was to be hoped that our enterprising shipbuilders will not be slow in realising the same speed in steam-boats which the railway engineers have done on the rail, and that, by the elaboration of the self-same proposition—namely, *that the resistance to motion may be made the same for all velocities.* A considerable advance in speed has been attained of late years by *fining the lines* of steam-boats, by cutting them in two, and inserting an addition to their length amidships, or by increasing their origiual length, though this last is often marred by a proportionately increased breadth of beam. That these were all steps in the right direction, and tend to support the principle just stated; but that nothing short of an attempt to reach thirty or forty miles an hour will satisfy the occasion. Mr. Sang, Mr. Elliot, and Mr. Swan, discussed the subject of the paper at some length; and while they admitted, as mathematicians, the correctness of the principle advanced by Mr. Aytoun, considered that that gentleman had not given sufficient weight to other sources of resistance to the motion of boats, such as friction, which would become very formidable when boats of the great length which he advocated were urged to extreme speed.—Referred to a committee.

5. Mr. Sang exhibited and orally described, on behalf of Mr. Waterston, 56, Hanover Street, *A Prussian-Slate Globe for Class demonstrations in Geography, Astronomy, and Trigonometry,* constructed on Mr. Sang's suggestion.—Thanks voted.

The following donations were laid on the table, viz. :—

1. *Unsafe Shipbuilding, a National Sin.* In reply to a despatch of His Grace the Duke of Newcastle upon the unsafe transmission of emigrants. By James Ballingall, surveyor of shipping and hon. secretary to the Port Philip Immigration and Anti-Shipwreck Society. 1st and 2nd editions. Melbourne, 1855. Presented by the author.

2. *Journal of the Society of Arts* of London, Vol. iii., 1854-55. Presented by the Society.

3. List of Premiums awarded by the Council of the Institution of Civil Engineers, London, session 1854-55; and list of subjects for communications for the following session (1855). Presented by the Institution.

4. *On the Composition of Bread.* By Douglas Maclagan. (1855.) Presented by the author.

Thanks voted to the donors.

Private Business.—The minutes of last meeting were read and approved. The followiug candidate was elected an ordinary fellow, viz.:—George H. Slight, engineer, 34, Leith Walk. The report of the Auditing Committee on the Treasurer's books and on the funds of the Society was read; Mr. Horne, convener. The President granted discharge to the Treasurer.

The Society then adjourned.

CORRESPONDENCE.

MODES OF FASTENING.

To the Editor of The Artizan.

Sir,—However strong may be the materials of which a machine is made, yet, if the fastenings be weak, the whole is liable to failure. The different modes of fastening became, therefore, a subject of Sir Samuel Bentham's minute investigation; and however reluctant I may be to bring his name forward so frequently, I would fain hope that some explanation of the different fastenings he contrived on a scientific plan, may possibly be the means of drawing the attention of the readers of The Artizan to this so important part of a structure.

It was to resist the force with which, in many cases, one piece slides over another, that coques were invented. A coque is a cylindrical piece of wood or metal, of from 3 to 6 inches diameter, one half of which being let into one of the pieces to be connected, aud the other half of the coque let into the other piece, the two pieces are thus prevented from sliding over one another. It was invented in 1800, and was chiefly used in making masts, in lieu of tabling them; but it is useful iu all cases where the object is to prevent the sliding of one piece over another. It has also collateral advantages, such as the saving of as much of the material as was formerly cut away in tabling, and also a saviug of labour, which, in the instance of a mast, amounted to twenty-five per cent. in the price paid for workmanship in the royal dockyards.

The treenail in common use is an unscientific fastening; it is frequently not even cylindrical or straight, and when inserted into the parts it has to hold together, its uniform diameter requires it to be forcibly inserted along its whole length, thus injuring both treenail and the wood it passes through; aud being of the same diameter throughout, it of course bears no relative proportion to the strains it has iu different parts of it to resist—Sir Samuel therefore invented *step*-shaped treenails, which were used in his experimental vessels in 1795. On an official examination of the *Dart*, after she had been seven years in active service, it was reported to the Admiralty that these step-shaped treenails had kept the planking of the vessel close to the timbers, which ordinary treenails "cannot perform." These step-shaped treenails were larger at their heads, where they are exposed to the severest strain, and then of diminished diameter along their length, not in a *tapering* form, but suddenly, by two, three, or more steps, and holes were bored for them by a tool having corresponding gradations. Thus, the treenail could be inserted by hand up to the head, when only one or two blows of the mallet were required, thereby diminishing labour, and, what is more important, avoiding injury to either timbers or treenails. Step-shaped treenails were coming into use when the General was sent to Russia.

Excepting for clincher job-work, in boat-building, all nails used in this country were, till lately, of an unscientific form, that is, tapered from head to point in both directions; easily driven in, it is true, but as easily falling out. Sir Samuel, perceiving this defect in the ordinary nails, devised wedge-shaped sheathing nails, for his experimental vessels. It may be observed that in driving them into soft-grained woods, it is probably immaterial which way the wedge is placed; but when the fibres run in a longitudinal direction, as iu fir, the wedge should be inserted in a transverse direction to the fibres.

Another fastening, which he invented at that time, was a short copper screw for fastening the butt ends of the planks in the experimental vessels. In some other parts, in lieu of bolts, he used screws of a large diameter; but to save the cost of so much copper, they were made hollow, and after they were inserted, were filled up with wood. Screws have been employed in royal dockyards for some parts of iron ships, but their diameter is not sufficiently large to have a firm hold. The need of such screws in timber vessels has been superseded almost entirely by the above-mentioned bolt-nails, which are now much used.

In timber-built ships, the mode of fastening the parts together by means of bolts clenched, to draw them tight, appearing to Sir Samuel unscientific, he sought to remedy their defects. He saw that the exterior end of a bolt had no other hold than that of friction, and that the interior end, being clenched, could hardly be drawn tight enough; also, that there were no means of altering the length of the bolt as the wood shrunk or expanded, and that the ends of the bolt gulled the wood through which it passed. To remedy these evils, he devised the resting the heads of bolts on metal plates as well as the inner ends, and that screws should be put on the inner end of a bolt, with nuts to screw upon them. He proposed the adoption of this improvement, as a general measure, iu 1805, and invented appropriate tools for cutting the screws.

M. S. Bentham.

IMPROVED MODE OF WORKING SHIPS' GUNS.

To the Editor of The Artizan.

Sir,—Willing as the public is to furnish money for the prosecution of the war, still no efforts should be spared to diminish the necessary cost of it, and I now venture to point out a means by which at least half the number of men for working ordnance might be spared, whilst at the same time the efficiency of the guns would be increased. The mode in question is that of mounting long guns in pairs, and in such a manner that the recoil of one piece should draw out the other. This was an invention of the late Brigadier-General Sir Samuel Bentham, and was practised by him in the Liman of Otchakoff. He says of it: *"Having, when these fittings were completed, had the command of the flotilla next under Prince Nassau-Liegen, I had sufficient experience of the efficiency of the modes of arming adopted, particularly of the 36-pounders, mounted to draw out one the other alternately (having poiuted them myself on board my own vessel in the most important action), and as no time was lost in moving the guns for any purpose, either in the vessel where the recoil was made useful, or in others where there was no recoil, so great was the number of shot thrown by them, that I am confident they did more mischief to the enemy than could have been done by vessels armed with twenty such guns mounted in the usual way." This opinion was confirmed by actual success, for though his vessel was no better than one of the galleys which had brought the Empress Catherine II. down the Dnieper, yet, after a long combat, he actually took a ship of the line, and made 400 prisoners.

The peculiarities of this mode were the connecting two guns together by a breeching, and passing it around a pulley within the vessel, the breeching being just long enough to allow one gun to be at the port, whilst the other piece is within board, ready to be loaded. The long guns so fitted by Sir Samuel were bow-chasers, but there seems no reason why a whole broadside should not be similarly placed in pairs, the pulleys being either over head or under foot.

It has been observed, in regard to fitting guns in pairs, that the ordnance now employed is of much larger calibre than formerly, and that a method advantageous for a 32-pounder might not suit for a 68-pounder. But why so? The carriage in both cases would be the same; so would the bearing on the deck of a vessel; the only difference would consist in giving proportionally greater strength to both the breeching and the pulley. It must be recollected too, that although ordnance of larger calibre than formerly are now employed as bow-chasers, yet the broadsides receive, as formerly, 32-pounders.

You have already been good enough to afford space in your important columns for noting some of the advantages of the principles of non-recoil, and at length it has been discovered why that principle has been discontinued; it is that a ship's side is not strong enough to resist the strain upon it, and that the men are, on that principle, exposed to the enemy's fire. In answer to these objections, it may be observed that vessels are now much stronger than they were at the beginning of the present century, for Sir Samuel's means of giving strength are now universally adopted,—such as fixed bulkheads, diagonal struts or braces, &c., as exemplified in his experimental vessels of 1795; yet, weak as

* "Naval Essay," No. I., p. 55.

vessels formerly were, not one of the many he fitted on the non-recoil principle were ever found too weak to bear the shock of firing their guns. As to exposure of the men, this was avoided by having a runner of rope instead of an inflexible one, thus avoiding exposure of the men; and, in fact, in actual warfare the casualties in vessels armed on the non-recoil system were no more than in ordinary combats, nay, even fewer, for on board the *Millbrook*, after a two hours' engagement, not a single man was killed.

By the adoption of either of these modes of mounting ordnance, the saving so made would amount, in seamen's wages and victual, to no less than a quarter of a million annually as long as the war lasts; nay, that estimate is much too low, for in fact it would amount to the sparing at least half of the men required to work the guns, the number now allowed for every 32-pounder being fourteen.

I am, Sir, your obedient servant, M. S. Bentham.

PUNCHING AND SHEARING MACHINES.

By Messrs. Davie and Stephens, Erie, Pa., U.S.

Fig. 1 is a side-elevation, and Fig. 2 a transverse vertical section of the working parts. Similar letters refer to like parts.

A is the frame of the machine; Z is the upper shear bolted to the frame; R is the lower shear. P is the rod which moves the lower shear. Q is the casting to which the lower shear is fastened, and which moves between gibs in the way piece, *a*. U and H are slides which complete the connexion between the punch and shears and levers. E, E, are guides for the slides. T is a lever to operate slide U. O is the lever which works the shear, and is connected with the yoke, J, in which are the friction rollers, K, K, (the bearings of which are dotted), between which is the cam, G, Fig. 2. The opposite end of the yoke, J, is connected with the lever, M, which operates the punch, B. F is a strap from punch, B, to lever, M. W, W, are bearings of levers. I is a small hand lever on pivot, *e*, to throw slide, H, between the punch and lever. D is a shield for the punch point. C is the die, held in its place by plate, N. *l*, *l*, are springs to throw back the hand levers. *b*, *c*, *d*, are necessary gearing and fly-wheels for giving motion to the machine.

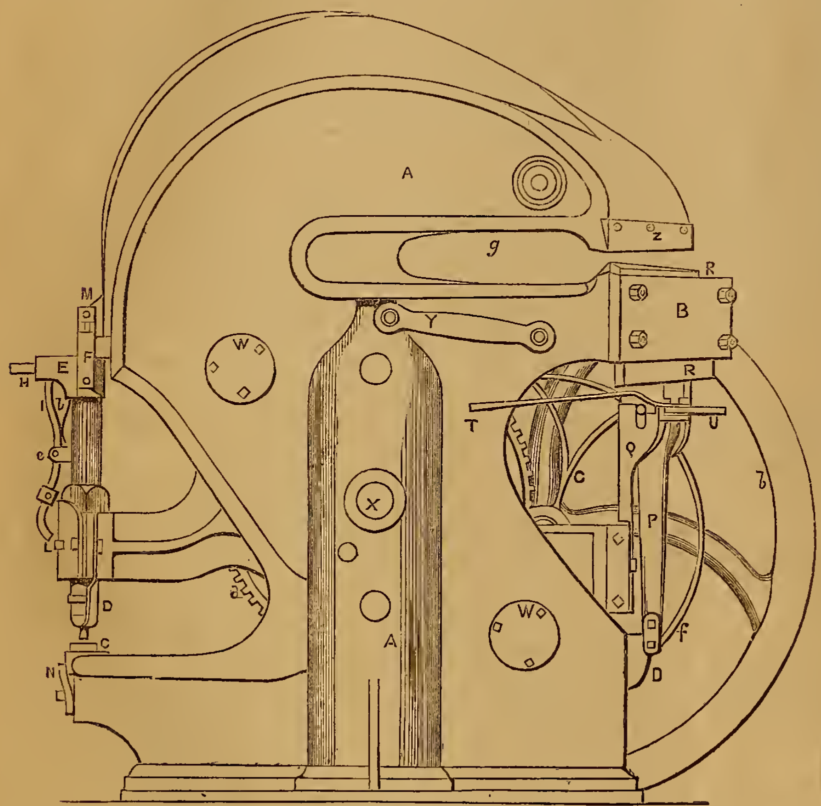


Fig. 1.

Operation.—The rotary motion given to the cam, G, forces the yoke, J, and with it the vibrating levers, O and M, alternately up and down. The slide, U, being moved between the rod, P, and the iron piece, Q, the shear is forced up by lever, O, cutting whatever is between Z and R. The slide, U, being withdrawn, the shear is not moved up by the next upward motion, but drops, and is prevented from falling too low by lugs cast on the back of Q, coming in contact with the top of casting, *a*. The slide, H, is moved between B and M, and operates in the same way as U; on the slide, H, being withdrawn, the punch, B, is prevented from falling too low by the lower end of the hand lever, I, resting on the lug, L. The opening, *g*, is long enough to allow the largest size boiler iron to be slit through the middle; to prevent straining the spring of the jaws when cutting heavy bars, the yokes, Y, are put on, but they are removable at pleasure.

The advantages claimed for this machine are, first, its compactness, a punch and shear being in the same machine, and driven by the same shaft, and yet so arranged that workmen may be engaged at both the same time without interfering with one another. Second, the punch or shear is disconnected, and again connected without any shock or stopping the machine. Third, great power and smoothness of operation obtained, with little friction, by the use of the cam, friction rollers, and yokes. It is one of the best inventions of the kind with which we are acquainted.—*Scientific American.*

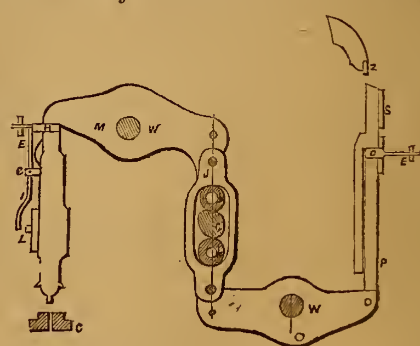
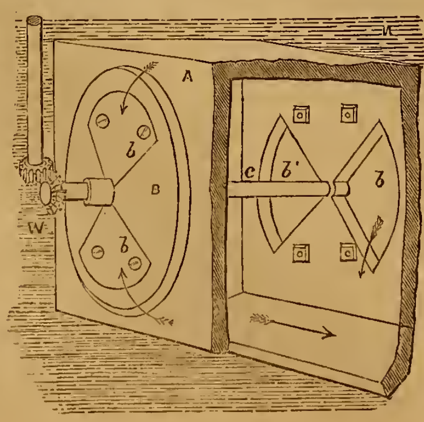


Fig. 2.

PATENT BALANCE WATER-GATE.

This figure is a perspective view, showing the inside of an improved balance water-gate, for which a patent was obtained by E. N. Moore and J. H. Hanyan, of Lenoxville, Pa., on the 24th of July last.



The nature of the invention consists in placing two gates on a shaft, to close, and expose openings in the sides of a box, and permitting the water to enter the box through the two gates, in opposite directions, whereby the pressure of water on one gate is neutralised by its pressure on the other, thus forming a balance-gate.

A represents a covered box with one outlet open side. It is placed in a flume or pond, and is surrounded on all sides, except the outlet, by water, W, W. B is an annular seat on one end of the box; there is a similar one on the other side on the other end. C is the gate shaft; it passes through the centre of the annular seats, B. *b*, *b*, are the valves or water-gates, they are secured by collars on the shaft, C. On the opposite end of the shaft outside there are two similar gates secured to the shaft, C. These gates are fitted snug to work water-tight in their circular seats, B. Section openings or slits, *b*,' *b*', are cut in the sides of the box, and the gates cover them. These slits or openings are water passages. When the gates close them, no water enters the box, A; when the gates expose these openings or slits, the water rushes into the box through them in opposite directions, as shown by the arrows, and then out at the near side. This action of the water balances the pressure on the gates. It will be observed that the pressure of the water on the gates on the shaft, C, is equal, but exerted in opposite directions, and thus the one gate acts as a counterpoise to the other. The shaft, C, of the gates can, therefore, be operated with ease, and the gates are opened and closed with the exercise of but little power. The form of the gates and their seats may be different from those represented, but circular discs with sector recesses, as shown, are perhaps the best. This balance water-gate is very sensitive to the action of a governor, and is, therefore, well adapted for regulating the flow of water through the penstock, according to the work to be done.—*Scientific American.*

BROWN'S PATENT SOUNDING INSTRUMENT.

The accompanying engravings represent an instrument for sounding or ascertaining the depth of the ocean, for which a patent was granted to Capt. C. F. Brown, of Warren, Rhode Island, on the 6th of June last.

The invention relates to a new and useful instrument for sounding the ocean depths, and consists in attaching to a spindle a long spheroidal chamber, containing some gunpowder within the lower part, and having underneath the chamber a needle operated upon by a spring, which is forced against a percussion-cap on a nipple, and thereby igniting the charge of powder when the lower end of the spindle strikes the bottom; and the time that elapses from the period the instrument is dropped until the sound is heard, or concussion felt, is noted, and the depth determined upon positive data, to form proper conclusions.

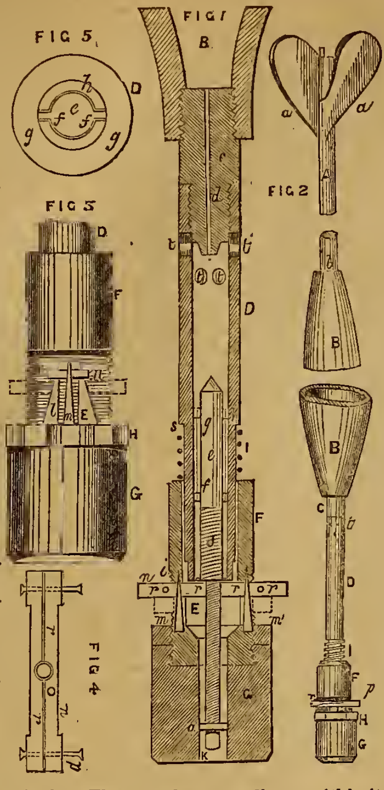


Fig. 1 is a vertical section of the lower portion of the instrument, showing its mechanism. Fig. 2 is an external view of the instrument. Fig. 3 is an enlarged outside view of the lower extremity. Fig. 4 is a detached top view of the clamps, and Fig. 5 is a top view of the tube which contains the needle, showing the collar and slots in which the feathers on the needle-head work. Similar letters refer to like parts.

A is the spindle of the instrument; it has two spiral flanches, *a*, *a*, at its upper end. B is a metallic chamber filled with a requisite quantity of gunpowder. The lower part of spindle, A, has a screw cut on it, and it is screwed into the upper part of chamber, B, at *b*, and is made watertight. In the lower end of the chamber there is screwed, watertight, a nipple-piece, C, with a nipple, *c*, at its lower end; *d* is a small hole running through it, and communicating with the interior of the chamber. A thread is cut on the lower side of the nipple-piece, and is screwed into a tube, D, which is about the same diameter as the spindle. This tube has a needle, E, within it, on the upper part of which is a head, *e*, which has two feathers, *f*, *f*, in it, fitting in slots, *g*, *g*, in a collar, *h*. Underneath the head, *e*, and around needle, E, above the bottom, *i*, there is a spiral spring, *j*. The lower part of needle, E, has a screw-thread cut on it, and it extends through an aperture in the bottom of the tube, D. The lower part of the tube fits closely within a metal socket, F, on the outer lower part of which a thread is cut, and screwed into a small metal cylinder, G, having an aperture, *k*, through its centre, as shown in Fig. 2. H is a nut working on the lower part of the socket, F. This socket has two triangular openings, *l*, *l*, cut through its sides; on its bottom there are two triangular vertical pins, *m*, *m*, placed about the centre of the openings, *l*, one in each. A clamp or nut formed of two horizontal plates, *n*, *n*, is placed through the triangular openings, *l*, *l*. The lower part of the needle, E, passes through the plates, *n*, *n*. A half circle is cut on each plate, with a thread formed on them, and forming, when together, a circular opening, *o*, Fig. 4. The plates, *n*, *n*, have a pin, *p*, at each end, passing loosely through them, allowing them to be forced apart or brought close together, and to keep them in their proper place. *r*, *r*, are small apertures (between the plates, *n*, *n*), in which the tops of the triangular pins fit when forcing the plates apart.

The needle, E, is depressed within the tube, D, by turning the small cylinder, G; or, if the tube, D, is detached from the nipple-piece, C, and then turned, the same object will be effected. The needle is prevented from turning within the tube, D, by means of the feathers, *f*, *f*, fitting in the slots, *g*, *g*, in collar, *h*, and consequently the needle is forced downwards as its lower end passes through plates, *n*, *n*, which form a nut. As the needle is depressed, the spring, *j*, is proportionately compressed, and when sufficiently so, the tube, D, is screwed on the nipple-piece, C, and the nut, H, screwed downward from the plates, *n*, *n* (dotted lines), to the position shown in Fig. 3. These plates are then, of course, free from the nut, and the small cylinder, G, is prevented from being moved accidentally upward, by a light spiral spring, I, resting upon the upper part of the socket, F, and against a shoulder, *s*, *s*, on the tube. When the parts are in this position, as shown in Fig. 2, the needle may be termed "cocked." It will be observed that if the small cylinder, G, at the foot, be driven upward, that the triangular pins, *m*, *m*, will force the plates, *n*, *n*, apart, and the needle will then spring upwards and strike against the percussion-cap on nipple, *c*, by the action of the spiral spring, *j*. A small nut, *u*, is placed upon the lower end of needle, E, merely to prevent the separation of the cylinder, G, and the tube when the needle is not cocked.

Operation.—The needle is first cocked within the tube, D, as described, and the instrument is gently lowered into the ocean until the flanches, *a*, *a*, are on a level with the water surface, when it is dropped. The spiral flanches, *a*, *a*, will cause the instrument to rotate as it descends, to insure a vertical line of descent. When the small cylinder, G, strikes the bottom, the resistance of the spiral spring, I, is overcome by the momentum, and the triangular pins, *m*, *m*, force the plates, *n*, *n*, apart, liberating the needle, the coiled spring, *j*, of which drives it up against the percussion-cap on nipple, *c*, igniting the charge in the chamber, B, and making it explode. The sound of the explosion will be heard or the concussion will be felt at the surface of the ocean, by those who have let down the instrument, and the time which elapses between letting it fall and hearing the sound of the explosion must be ascertained by a stop watch. By this means the depth of the ocean may be ascertained, for a table may be formed from a number of recorded experiments, giving the time between the dropping of the instrument, and that when the sound is heard at the surface, according to ascertained depths. A percussion-cap can be used on the nipple, or a pill of an alloy of potassium. Water is required to ignite the latter, and for this purpose small apertures, *t*, are left at the upper part of the tube, to be opened when the instrument strikes the bottom.—*Scientific American.*

THE "PERSIA" ROYAL MAIL STEAMER.

The *Persia* was built and completely fitted by Messrs. Napier and Sons for the Cunard line of mail steamers, and is the only one which is built of iron, Government having previously objected to these vessels being made of that material, as they might be required for naval purposes as vessels of war, for which object it was not considered that iron was suitable.

The hull is formed entirely of iron plates; except the decks, from the keel to the monkey-rail above the bulwarks, there is nothing but iron. The keel is a huge iron bar, 13 in. deep and 4½ in. thick, scarfed at intervals, and with the stem and stern posts carried several feet along the keel. To the keel the garboard-strakes are rivetted by two rows of strong rivets, and come down flush to its lower edge. These plates next the keel are $1\frac{1}{16}$ inch in thickness, decreasing to 3-4ths of an inch at the load-line, the top sides being 11-16ths thick. The bulwarks are also of iron, and are about 7 ft. above the deck.

On the upper deck are two large saloons, one of them 60 ft. long by 20 ft. broad. Continuously with these are the steward's pantries, kitchen, quarters for the engineers, and a host of other apartments, extending in all to about 300 ft., but only so broad as to leave a wide passage all round between the deck-house and the bulwarks. The only portion of the main-deck which is not thus built upon is that directly over the crank end of the engines which is left open, but protected from the weather by the hurricane-deck above. The main saloon aft is chastely fitted up in bird's-eye maple. There are large plate-glass windows at short intervals on each side, the intervening panels being filled in with designs on painted glass. There is a fixed sofa along each side, under which air and light are admitted to the 'tween-decks.

The crew and firemen are accommodated in the forecastle; and where the breadth of the ship admits, there are a series of useful out-offices placed along the sides.

The lower-deck is devoted almost exclusively to sleeping accommodation for about 300 passengers. There is, however, an elegant boudoir or drawing-room for the ladies, and another apparently for gentlemen. The whole of the cabins are warmed by means of steam-pipes.

There are four rows of sleeping-cabins, with two berths in each. The outside rows are lighted through circular dead-lights in the sides, whilst the two central rows are lighted from the deck above through a series of windows placed under the sofa-seats of the saloons, &c. There is ample provision for ventilation in every cabin, and the candles are placed in lockfast, fixed lanthorns, each one lighting two cabins as well as the passage. Risk of fire is thus reduced to a minimum, as the passengers have no control over the lights. In each cabin there is a basin-stand supplied by water-taps from a cistern, and there are also all the other toilet requisites for a comfortable bed-room; so that passengers may be exceedingly snug in their little, well-ventilated apartments. The height between decks is 8½ ft.

There are two engines, with steam-cylinders of 100 in. diameter, and a stroke of 10 ft. As they make about 18 double strokes a minute, the piston travels through 360 ft. a minute. In the principle of the engines there is no novelty. They are of the side-lever kind, and are placed with the connecting-rods towards the stern, so that the paddle-wheels are also abaft midships.

There are eight boilers placed in two groups, one before and another abaft the engine-room. The boilers in each group stand with the furnace-doors face to face, having a wide passage between in a line with the keel, from which they are fired. The flues from the four boilers converge into one circular opening, over which is placed a funnel or chimney about 8 ft. in diameter, and rising about 30 ft. above the deck.

Each boiler has five fire-places, above which are the tubes, and through them the products of combustion pass up to the chimney. There are thus forty furnaces in all.

As there are two sets of boilers working independently of each other, there are two chimneys or funnels — one before and the other abaft the engines; and some idea of the enormous extent of space required may be formed when we mention that the engine-room is 115 ft. long and nearly 45 ft. broad. There are, besides, two donkey boilers and engines for pumping the feed-water into the boilers; and in connexion with them are eight refrigerators for abstracting the waste heat from the brine, as it is blown off from the boilers, to heat the feed-water.

The coal-bunkers are placed beyond the boilers at each extremity of the engine-room, and are of sufficient capacity to hold about 1,400 tons of coal, of which, it is supposed, that the daily consumption will not be less than about 130 tons. The paddle-wheels are 40 ft. in diameter, with fixed wooden floats, 10 ft. by 3 ft.

There is a stowage for about 1,200 tons of cargo in carefully-built holds. This may appear a small bulk of merchandise for so large a ship to carry, but it must be remembered that the power alone requires the largest half of the ship's capacity, and that the passenger accommodation is the primary object.

The following are the principal dimensions:—

Length from figurehead to taffrail	390 ft.
Length between perpendiculars	376 ,,
Breadth of hull	45 ,,
Breadth over paddle-boxes	71 ,,
Depth	30 ,,

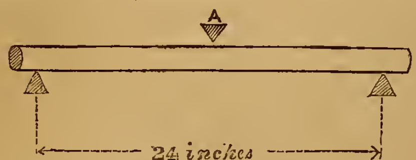
Gross tonnage	3,300 tons.
Space for propelling power	1,221 ,,
Power of engines	900 H.P.
Total weight on her trial trip	4,100 tons.
Weight of engines and boilers, about	1,100 ,,

This magnificent new steam-ship (Captain Judkins) arrived in the Mersey, January 10, at 3.40 A.M., from the Clyde, having performed the voyage from the Cloch Lighthouse to the Bell Buoy, a distance of 203 miles, in the short space of 10 hours and 43 minutes. She started from the Cloch light on the 9th at 4·56 P.M., and made the Cumbraes, a distance of $14\frac{1}{2}$ miles of intricate and tedious navigation, in 1 hour and 1 minute; from the Cumbraes, in 1 hour and 7 minutës, she was abreast of Pladda light; and at 7·36 she had made Ailsa Craig, a distance of 43 knots from her starting point; at 8·40 she was off Corsewall Point, reaching the Mull of Galloway at 10·12. The Point of Ayre, in the Isle of Man, was passed at 11.45 P.M.; and at 3·40 A.M. on the 10th she reached the Bell Buoy, a distance of 175 knots, or 203 miles, in the time already specified, having thus sustained an average speed of 19 miles an hour during the whole voyage.

MEETING OF FRANKLIN INSTITUTE.

At a recent meeting of the above Institution, Mr. Macpherson stated, that wishing to obtain a strong composition mixture to be used for marine purposes, he had recently made the following experiments:—

All the bars being turned to a diameter of $2\frac{1}{16}$ in., and a length of 25 in., the weight being applied at A, as shown:—



No. 1 was composed of 10 lbs. copper, 10 oz. tin, 12 oz. zinc, 8 oz. lead, deflected quickly to $7\frac{5}{8}$ in., and broke with 6,874 lbs. at A.

No. 2 was composed of 6 lbs. copper, 4 lbs. zinc, deflected slowly to 2 in., and broke with 6,489 lbs. at A.

No. 3 was composed of 2 lbs. copper, 1 lb. of zinc, deflected quickly to $7\frac{9}{16}$ in., and broke with 6,158 lbs. at A.

No. 4 was composed of 9 lbs. copper to 1 lb. of tin, deflected slowly to $4\frac{1}{4}$ in., and broke with 7,802 lbs. at A.

No. 5 was composed of 10 lbs. copper, 1 lb. of tin, 4 oz. zinc, deflected slowly to $7\frac{1}{2}$ in., and broke with 10,530 lbs. at A.

No. 6, same mixture as No. 5, cast several weeks later, deflected very slowly to $7\frac{1}{2}$ in., and sustained, without breaking or showing the least fracture, a weight of 11,695 lbs. at A.

No. 7 was composed of $8\frac{1}{2}$ lbs. of copper, 8 oz. tin, 1 lb. zinc, deflected slowly to $5\frac{5}{8}$ in., and broke with 6,461 lbs. at A.

No. 8, same mixture as No. 1, with the addition of 1 lb. tin to every 12 lbs. of the mixture, deflected very slowly to $\frac{1}{4}$ inch, and broke with 5,333 lbs. at A.

A piece of refined bar iron, of same length and diameter, deflected slowly to 4 in., and sustained at A a weight of 12,375 lbs., and, by increasing to 17,000 lbs., it deflected to $5\frac{1}{2}$ in.

Mr. Macpherson exhibited specimens illustrating the results of these experiments.

Mr. M. B. Dyott exhibited a model of his improvement in warm air furnaces. This is at present under consideration by the Committee on Science and the Arts.

NOTES AND NOVELTIES.

Strike in the Shipbuilding Trade.—The strike among the joiners in the yard of Messrs. William Denny Brothers, of Dumbarton, has now extended to nearly every yard in the burgh, and includes all departments connected with shipbuilding in which Unionists were employed. Some hundreds of labourers, too, who had no connexion with unions have also been thrown out of employment in consequence of the absence of the other workmen from the yards. What gave the strike such a magnitude was a notice signed by all the builders in the burgh, except Messrs. Denny and Rankine, and posted up in the different works on Thursday last, stating they had resolved, in order to protect themselves and those of their men who had no desire to connect themselves with trades' unions, that, on and after the 3rd Jan., 1856, no tradesman in any of the branches in their yards belonging to a trades' union would be employed by them. All tradesmen not belonging to a union, or those willing to sign a paper that they had ceased connexion with such, directly or indirectly, would have employment at the highest rate of wages paid in Clyde. A considerable number of men left the yards immediately on seeing this, but being New-Year's week, when many men were idle according to custom, and some yards closed for the purpose of repairing machinery, &c., it was not easy to ascertain the exact extent of the strike till the beginning of the present week. The total number of unionists now on strike amounts to 378, and the number of labourers who have been thrown out of employment in consequence of the strike amount to 320. A grand total of nearly 700 men are thus out of the yards in Dumbarton, and as the prosperity of the town depends almost solely upon this single branch of trade, considerable uneasiness is felt as to the result of the struggle. As yet there is little prospect of an amicable settlement being come to, the men and masters being both equally convinced of the justness of their case. On the evening of Tuesday a general meeting of all the branches now on strike was held in the large hall of the Elephant Hotel, when the following resolution was put to the meeting, and carried by acclamation:—"That inasmuch as, by the proceedings of this night, this meeting conceives that the joiners and other members of trades' unions have been grossly ill-used by the employing class in Dumbarton, we, the inhabitants, sympathise with them in their present position, and endeavour to express our sympathy with them in substantial support.—*Dumbarton Herald.*

The Translation of the French Metre into English Feet.—Like painting, both arithmetic and music speak a universal language; but it is not so with mensuration, for the measures established in different countries vary so greatly as to cause considerable inconvenience, and great inaccuracy also, as to the dimensions of foreign buildings, stated upon the authority of books, without any notice being taken of the difference of the foot measure in different countries; or, if the reckoning be by foreign measures otherwise named, such as the braccio, palm, vara, elle, &c., their exact proportion to our English foot is not explained. Such inconvenience, however, is now, in some degree, lessened, by the French mètre beginning to be adopted on the Continent as a common or universal standard of measurement; not, indeed, in actual practice, but in architectural publications, in which, whether they be German or Italian, two scales are given; one according to the popular, or, so to say, vernacular mode of computation, the other in the terms of the French mètre. Thus the mètre becomes the key to Continental mensuration. Nothing more is required than to measure by the French scale, and then convert the mètres into English feet;—a rather tedious operation if it had to be performed by multiplication every time, but rendered short and simple enough by the following table, for which the exact value of the mètre is taken from Woolhouse's Tables of Continental, Lineal, and Square Measures, appended to the translation of Moller's "Memorials of German-Gothic Architecture," published by Weale, 1836.

Table for converting French mètres into English feet.

1 mètre	=	3·2809 English feet.
2 ,,	,, ...	6·5618 ,,
3 ,,	,, ...	9·8427 ,,
4 ,,	,, ...	13·1236 ,,
5 ,,	,, ...	16·4045 ,,
6 ,,	,, ...	19·6854 ,,
7 ,,	,, ...	22·9663 ,,
8 ,,	,, ...	26·2472 ,,
9 ,,	,, ...	29·5281 ,,

Values of the Decimal Fractions.

·0833	=	1 in. English.
·1666	,, ...	2 ,,
·2500	,, ...	3 ,,
·3333	,, ...	4 ,,
·4166	,, ...	5 ,,
·5000	,, ...	6 ,,
·5833	,, ...	7 ,,
·6666	,, ...	8 ,,
·7500	,, ...	9 ,,
·8333	,, ...	10 ,,
·9163	,, ...	11 ,,

This table will be found to answer the purpose of a "Ready Reckoner," and is to be used in the following manner: for *units*, the table itself shows what number of English feet correspond with that of the mètres; thus, 9 mètres make 29 English feet and ·5281 decimal parts, the value of which can be ascertained with sufficient exactness for general purposes from the list of decimals and inches, viz., 6 in. and a fraction. In the case of *tens* or *hundreds* of mètres, the lines of figures are to be set down as in multiplication, and added up. Thus, supposing the number of mètres to be 36:—

6 = 19·6854
3 = 9·8427
118·1124

or 118 ft. and nearly $1\frac{1}{2}$ in.

Although not perfectly exact, this will be found sufficiently so for ordinary purposes, when the fractional part of an inch, more or less, can be of no consequence in the aggregate number of feet and inches.—*Building News.*

NOTICES TO CORRESPONDENTS.

The Paris Exposition, 1855.—By mistake the name of Goëbe was printed at page 3, 1st column, in our Number for January, as having exhibited two models of inclined screw-engines, which were considered worthy of mention. The engines referred to were designed and manufactured by M. Gache (the Elder), of Nantes.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 29th August, 1855.

1951. Charles Pope Rosson, Manchester—Improvements in machinery or apparatus employed for dressing and finishing textile fabrics, by the application of a new material in the place of hogs' bristles or wire cards, hitherto employed therein.

Dated 6th September, 1855.

2018. Charles Pryse, Birmingham, and Paul Cashmore, West Bromwich—Improvements in repeating fire-arms.

Dated 2nd October, 1855.

2197. William Horton, Birmingham—Improvements in the breech part of fire-arms.

Dated 18th October, 1855.

2336. Samuel Statham, Islington—Improvements in electric telegraph cables.

Dated 9th November, 1855.

2520. John and William Olive, Woolfold, near Bury—Improvements in the manufacture of wheels for railway and other purposes.

Dated 13th November, 1855.

2550. Robert Tempest, and James Tomlinson, and Richard Hampson, and John Hampson, Rochdale—Improvements in looms for weaving, which improvements are applicable to working the valves of steam-engines.

Dated 17th November, 1855.

2596. Joseph Shaw, 22, New King-street, Hull—Improvements in the prevention of accidents arising from collisions on railways.

Dated 19th November, 1855.

2599. Thomas Culpin, 25, Royal-hill, Greenwich—Improved apparatus for regulating the supply and discharge of fluids and gases.

2601. Josiah Pratt, Bath-street, City-road, and Thomas Radcliffe, Shaftesbury-street, Hoxton—Improvements in the manufacture of brushes.
2603. John Silvester, West Bromwich—Improvements in steam gauges and safety-valves.
2605. John McNichol, Manchester — Improvements in machine or cylinder printing.
2607. Michel Pierre Alexis Gilardeau, 39, Rue de l'Echiquier, Paris—A new motive-power.

Dated 20th November, 1855.

2609. Theodore Schwartz, New York—Improvements in drying, heating, and melting solid and plastic bodies.
2611. George Geyelin, 13, Melville-terrace, Torriano-avenue, Camden-road—Propelling vessels by means of pistons, which he calls "Anti-friction Propellers," to supersede paddle-wheels, screws, and all other contrivances at present in use.
2613. Francis Puls, Soho-square—A new electric light and heat.
2615. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in apparatus for preventing horses from running away. (A communication.)
2617. Edward Orange Wildman Whitehouse, Brighton—Improvements in electro-telegraphic apparatus, parts of which are also applicable to other purposes.
2619. David Simpson Price, 2, South Molton-street, and Edward Chambers Nicholson, 3, Newington-crescent—Improvements in the manufacture of cast steel.
2621. George Senior Tolson, Robert Henry Tolson, and Joseph Senior Tolson, Dalton, Kirkheaton, York, and Thomas Irving, Mold-green, Dalton—Improvements in producing metallic lustre to yarns and fabrics. (A communication.)

Dated 21st November, 1855.

2625. Armand Jean Baptiste Louis de Marcesheau, Paris—Improvements calculated to increase the efficiency or working power of steam-engines.
2627. William Munslow and Henry Wallwork, Miles Platting—Improvements in railways.
2629. Thomas Wright Gardener Treeby, 1, Westbourne-terrace-villa, Westbourne-terrace-north, Paddington—Improvements in revolving fire-arms.

Dated 22nd November, 1855.

2631. John Roberts, jun., Whitechapel-road—A machine or apparatus for cooling tobacco during the process of manufacture.
2633. Edmund Calvert and Sidney Ashton Smith, Walton-le-Dale — Improvements applicable to carding-engines.
2636. Frederick Lotteri, Bergamo, Lombardy—Obtaining fibre from the bark of trees of the morus family or class, and the application thereof to the manufacture of paper and textile materials, and for other useful purposes.
2637. Charles Tennant Dunlop, Glasgow—Improvements in the manufacture or production of artificial oxide of manganese.
2639. Charles May, Great George-street, and Paul Prince, Derby—Improvements in the manufacture of spikes and treenails.

Dated 23rd November, 1855.

2643. John Henry Hutchinson, East Retford—Improved machinery for converting rectilinear motion into rotary motion.
2645. John Jobson, Litchurch, Derby—Improvements in the manufacture of railway chairs.

Dated 24th November, 1855.

2649. Jean Lobstein, Paris — Improvements in sewing-machines.
2651. Robert Knowles, Chorlton-upon-Medlock—Improvements in winding on in certain machines for spinning cotton and other fibrous materials.
2653. Charles Sanderson, Sheffield — Improvement in the manufacture of iron.

Dated 26th November, 1855.

2656. Denis Jonquet, 63 Mina-road, Old Kent-road—Improvements in the blades of mechanical cutting machines, and in the blades of single or double-handled cutting instruments, and in the blades of ordinary and mechanical shears and scissors, and in the handles and springs for the same.

Dated 27th November, 1855.

2655. Louis Joseph Frédéric Margueritte, Paris—Improvements in precipitating certain salts.
2657. John Wilkes, Birmingham — Improvements in the manufacture of tubes of copper and alloys of copper.
2659. François Coignet, 90, Rue Hauteville, Paris—Improvements in the use and preparation of plastic materials or compositions to be used as artificial stone, or as concrete or cement for building or other purposes.
2661. Frederick Osbourn, Aldersgate-street—Improved machinery for pressing, smoothing, or finishing garments or parts of garments.
2663. John Julius Clero de Clerville, Newman-street, Oxford-street — Improvements in preparing oil with other matters for painting. (A communication.)
2665. Robert Bell, 93, Glassford-street, Glasgow—Improvements in the manufacture of woven fabrics when made of wool and cotton, or of wool, cotton, and silk.
2667. William Edward Newton, 66, Chancery-lane — Improvements in breech-loading fire-arms. (A communication.)
2669. Hiram Hyde, Truro, Nova Scotia—An Improved manufacture of lubricating oil. (A communication.)
2671. Charles Rice, Massachusetts, U.S.—Improved method of manufacturing boots or shoes. (A communication.)
2673. Charles Rice, Massachusetts, U.S.—Improved process of preparing cloth so as to render it nearly, if not entirely, impervious to water, but not so to air, such cloth being particularly useful in the manufacture of boots and shoes, or various other articles of dress or utility. (A communication.)
2675. George Louis Stott, St. George's, Gloucester—Improvements in the manufacture of carbonate of soda.
2677. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in windlasses, capstans, and other purchases, parts of which are applicable to the transmission of motive-power. (A communication.)
2679. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture or preparation of india-rubber and gutta-percha, and in the applications thereof. (A communication.)
2681. George Richardson, Craig's-court, Charing-cross—Improvements in chain cables and other chains. (A communication.)

Dated 28th November, 1855.

2683. Charles Jean Baptiste Barbier, Paris—Improved kiln for burning or firing pottery, bricks, tiles, and other earthenware.
2685. Benjamin Rosenberg, New Charles-street, City-road—Improvements in protecting metallic and other surfaces from corrosion and decay. (A communication.)
2687. Richard Archibald Brooman, 166, Fleet-street—Improvements in the manufacture of sand, emery, and glass papers, and in the machinery employed therein. (A communication.)
2689. Samuel Wolff, Independence, Jackson County, Missouri, U.S.—Improvements in obtaining motive-power.
2690. James Walker, Leeds—Improvements in the manufacture of textile fabrics.
2691. Charles Clarke, Farm-lane, Walham-green, Fulham—Improvements in applying roughings to the feet of horses.

Dated 29th November, 1855.

2693. Thomas Symons, Flushing, Cornwall—Improvements in the permanent ways of railways, and in the wheels rolling thereon.
2697. Alfred Vincent Newton, 66, Chancery-lane—Improved process of manufacturing hats. (A communication.)
2699. Pierre Louis Bergeon, Paris—Improved spitting-box or spittoon. (A communication.)

Dated 30th November, 1855.

2701. Henry Thomas Humphreys and James Loughry, Kilmacow Mills, Waterford—Improvements in machinery or apparatus for cleaning wheat.
2703. Augustus Desautoy, Boulevard des Italiens, Paris—New and useful machinery for cutting cloth and other substances.
2705. Edward John Davis, 64, West Smithfield—Improvements in preparing food for horses and other animals.

Dated 1st December, 1855.

2696. Charles Maybury Archer, 3, St. James's-gardens, and Haverstock-hill, Hampstead-road—A new material for the manufacture of paper, and for the production of textile fabrics.
2707. Edmund Alfred Pontifex, Shoe-lane—Improvements in furnaces.
2709. William Needham and James Kite (Secundus), Vauxhall—Improvements in machinery or apparatus for expressing liquids or moisture from substances.
2710. John Gardner, M.D., 51, Mortimer-street, Cavendish-square—A method of treating tea for economising its use and transport.
2713. William Augustus Woodley, Taunton — Improvements in the manufacture of paper-bags.

Dated 3rd December, 1855.

2715. David Anderson, Strandtown-house, Down, Ireland—Improvements in machinery or apparatus for the preparation or manufacture of felt and other fibrous materials.
2719. William Rowan, Belfast—Improvements in steam-engines.
2721. Alexander Watt, 83, Dean-street, Soho—Improvement in coating iron and steel with zinc.

Dated 4th December, 1855.

2723. Samuel Garn, Sevenhampton, Wiltshire—Improved tipping apparatus applicable to carts and other vehicles.
2724. Etienne André Napoleon Brècheux, Paris—Improved axle-tree for carriages.
2726. William Foot, Wellington, Somerset—An instrument for moving and stopping trucks and other carriages on railways.
2727. Joseph Barling, 7, High-street, Maidstone—Improvement in the manufacture of paper by the application of a root not before used for the purpose.
2728. Jean Davoust, Hôtel des Invalides, Paris—Improvements in cartridges. (A communication.)
2729. William Knight, St. Marylebone—Improved mode of cutting out or shaping materials to be employed in making overcoats or other similar articles of dress.
2730. John Marsh, Nottingham — Improvements in the manufacture of looped and piled fabrics.

Dated 5th December, 1855.

2731. Adam Bullough, Blackburn—Improved lubricator for looms.
2732. John Moffat, Birmingham — Improvements in the manufacture of metallic spoons, forks and ladles.
2733. William George Plunkett, Belvidere-place, Dublin, and John Bower, Lower Ormond-quay, Dublin—The manufacture of fibres or threads for textile fabrics and cordage, also of paper, mill-board, and other similar boards, from plants or portions of plants not hitherto used for these purposes.
2734. William Nunn, 7, Church-street, Hackney — An improved table, washstand, mirror, &c., comprised in one piece of furniture.
2736. William Beatson, Rotherham — Improvements in treating borates of lime and magnesia, and a new composition formed therewith, suitable for glazing and for other purposes for which borax has been or may be employed.
2737. Cæsar Heilmann, 22½ Milk-street, Cheapside—Improvements in grates or furnaces for steam-boilers.
2738. William Smith, 82, Margaret-street, Cavendish-square—Improvements in apparatus for regulating the supply of air to furnaces.
2739. William Henry Smith, Wellington-chambers, Cannon-street-west—Improved construction of fastening, applicable to gaiters, stays, and other like articles.
2740. Alfred Vincent Newton, 66, Chancery-lane—Improvements in apparatus for dressing cloth. (A communication.)

Dated 6th December, 1855.

2741. Jonas Marland and Samuel Marland, Sun Vale Iron Works, Walsden—Improvements in power looms.
2743. William George Wilson, Penton-cottage, Newington-butts—A pneumatic moderator.
2744. William Mosley, Salford—Improvements in machinery or apparatus for stretching and finishing woven fabrics.
2745. Arthur Paget, Loughborough—Improvements in machinery or apparatus for the manufacture of looped or other fabrics.
2746. John Barrow, jun., Manchester—Improved process of manufacturing soda and sulphuric acid.
2748. Thomas Dunn, Glasgow—Improvements in fire-arms.
2749. James Rock, jun., Hastings—Improvements in the construction of tents, huts, and portable buildings.
2750. John Cornes, Swan-lane—Improved mangle or press, parts of which are applicable to rollers employed for pressure purposes generally.
2751. Thomas Chaffer, Liverpool, and Jonah Ellis, Vulcan Foundry, near Warrington—Improvements in machinery for sawing and cutting slate, stone, coal, salt rock, or other minerals.
2752. Johannes Neuenschwander, Berne, Switzerland—Improvements in the process of preparing what is called "Swiss whey" from milk.
2753. Rudolph Bodmer, 2, Thavies-inn — An improved planimeter. (A communication.)
2754. Thomas Russell Crampton, Adelphi — Improvement in furnaces, and in apparatus for supplying fuel thereto.
2755. Angier March Perkins, Francis-street, Gray's-inn-road—Improvements in apparatus for generating steam.
2756. Frederick Samson Thomas and William Evans Tilley, 6, Kirby-street — Improvements in producing aluminium and its alloys, and in plating or coating metals with aluminium and alloys composed of aluminium and other metals.
2757. Angier March Perkins, Francis-street, Gray's-inn-road—Improvements in warming buildings and apartments by hot water.

Dated 7th December, 1855.

2758. Jean Joseph Emilien François Kuister, Lyons—Improvements in raw silk winding machinery.
2759. Antoine Latta, Metz—Preparing gutta-percha in combination with other substances, applicable to various purposes.
2760. Henry Hart, 5, Waterloo-crescent, Dover—A ship leakage indicator. (A communication.)
2761. David Dick, Paisley—Improvements in machinery to be used in finishing cloth and textile fabrics.
2762. James Gardner, Plaistow, and Henry Gardner and John Carey Gardner, Leytonstone-road—Improvements in glasses as applied for the transmission of light.
2763. Hudson Cranston, Coronation-street, Sunderland—Improved method of manufacturing lozenges.
2764. Charles Lenny, Croydon—Improvements in carriages.
2766. John Allin Williams, Baydon, Wilts—Improvements in machinery or apparatus for cultivating land.
2767. James Leitch, 1, Ellenborough-street, Liverpool—Improvements in melting, blowing up, and filtering sugars and other saccharine matters.
2768. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of iron.

2769. John Gray, Strand-street, Liverpool—Improvements in azimuth and amplitude instruments.
2770. Charles Edmund Green, 13, Blandford-street, Portman-square—Improvements in huts, tents, and camp hospitals.
2771. Herman John Van den Hout and Ebenezer Brown, Kentish-town—Improvements in utilising leather-shavings.

Dated 8th December, 1855.

2772. Joseph Hacking, Bury—Improvements in machinery for supplying fuel and air to furnaces.
2773. Charles François Jules Fonrobert, Berlin—An artificial leech and a sucker.
2774. John Radcliffe and Thomas Vickers Favell, Rotherham—Improvements in machinery or apparatus for cutting sugar and other substances.
2775. William Norton, Kirkburton—Improvements in weaving pile fabrics.
2776. Andrew Tevendale, 2, Wellington-buildings, Vauxhall-road, Liverpool—Improvements in propelling, and in the construction of, steam or other vessels.
2777. François Devos, 2, Rue Dronot, Paris—Improvements in preparing and tanning hides and skins.
2778. Andrew Maclure, 37, Walbrook—Improvements in lithographic printing presses.

Dated 10th December, 1855.

2779. Joseph Wrigley and Jacob Norcliffe, Oldham—Improvements in shuttles, and in the method of using the same.
2781. James Cocker, Liverpool—Improvements in the manufacture of wire.
2782. Thomas Heppleston and John Hunter, Manchester—Improvements in machinery or apparatus for stretching and finishing yarns or threads.
2783. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the manufacture of safety paper. (A communication.)
2784. David Parsons, Pensett, near Dudley—Improved break for arresting or retarding at will the motion of locomotive and other engines and revolving machinery.
2786. Richard Archibald Broomau, 166, Fleet-street—Improvements in manufacturing gas from peat, and in treating hydrogen gas, in order to render it illuminating. (A communication.)
2787. Josiah George Jennings, Great Charlotte-street, Blackfriars-road—Improvement in the arrangement of the overflow pipes of baths, wash-hand basins, and other vessels.
2788. Josiah George Jennings, Great Charlotte-street, Blackfriars-road—Improvements in connecting earthenware rain pipes and soil pipes of water-closets, and in valve water-closets.
2789. Josiah George Jennings, Great Charlotte-street, Blackfriars-road—Improvement in the rising pipe and suction-valves of pumps.

Dated 11th December, 1855.

2790. Bernard Hughes, Rochester, New York, U.S.—A machine for making spokes and tool handles. (A communication.)
2791. Bernard Hughes, Rochester, New York, U.S.—A knot-tying sewing-machine. (A communication.)
2793. Jean Marie Préaud, Lyons—Improvements in india-rubber springs.
2794. Alexander Tolhausen, 7, Duke-street, Adelphi—Improvements in mariners' and land compasses. (A communication.)
2796. James Cliff, Burton-on-Trent—Improvements in or additions to furnaces.
2797. John Henry Johnson, 47, Lincoln's-inn-fields—Improved apparatus for discovering the leakage or escape of gas. (A communication.)
2798. Reuben Levy, Manchester—Improvements in wearing apparel
2799. Robert Adam Whytlaw and James Steven, Glasgow—Improvements in weaving.
2800. René Simon Bouet and Henri Emile Isidore Douein, Paris—Improvements in the preservation of meat and other animal substances serving for food.
2801. Alfred Vincent Newton, 66, Chancery-lane - Improved machinery for manufacturing bolts. (A communication.)
2802. Alexandre Forot, Paris—Improvements in parasols.
2803. Samuel Clarke, Albany-street, Regent's-park—Improvements in lanterns for affording light, and for cooking.
2804. Rogers Ruding, 51, Bunhill-row—Improvement in printing silks and other woven fabrics with gold and other metal leaf or powder.

Dated 12th December, 1855.

2806. Martin Billing and Walter George Whitehead, Birmingham—Improved waterproof fabric or material.
2808. George Heron Hay and David Sime Hay, Edinburgh—Improvements in photographic pictures.
2810. William Leighton, Newcastle-upon-Tyne—Improvements in paddle-wheels.
2812. Thomas Rickett, Stony Stratford—Improvements in pressure-gauges.

Dated 13th December, 1855.

2814. David Hart, Trinity-square—Improvements in signalling or communicating between parts of a railway train, and in the instruments and apparatus employed for such purpose.
2816. Alphonse Louis Poitevin, Paris—Improved photographic engraving.
2818. George Skelton, Lambeth—Improved projectile.
2820. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in apparatus for containing and distributing aëriform fluids under pressure. (A communication.)
2822. George Hall Nicoll, Dundee—Improvements in fire-places or heating apparatus.

Dated 14th December, 1855.

2824. William Philippi, 159, Regent-street—Improvements in coating iron with tin.
2826. George Tomlinson Bousfield, Sussex-place, Loughborough-road—Improvements in machinery for the manufacture of cut pile fabrics. (A communication.)
2828. Edward Orange Wildman Whitehouse, Brighton—Improvements in apparatus for measuring fluids.

Dated 15th December, 1855.

2830. William Henry Newman, 45, Cannon-street-road—Improved fire-lighter.
2832. Thomas Warren, Glasgow—Improvements in the manufacture and moulding or shaping of glass.
2834. Edward Brown Hutchinson, Moorgate-street—Improved apparatus for forming and cutting elliptical figures.
2840. Samuel Stewart, 28, Clement's-lane—Improved combined engine and gas exhauster, and also improvements in the valves of such exhausters.
2842. Paul Marie Salomon, Rue Neuve, St. Eustache, Jacques Loir Montgazan, Rue de Bondy, and Charles Marie Joseph de Flers, Rue Lafitte, Paris—Improvements in the manufacture of gas from coals and in the production of bituminous coke in that manufacture, and also in the apparatus connected therewith.

Dated 17th December, 1855.

2844. George Collier and John Crossley, Halifax, and James William Crossley, Brighouse—Improvements in apparatus employed in drying and stretching woven fabrics.
2846. Henry Stewart, Baker-street—A machine or apparatus for cleaning and polishing forks, spoons, and other like curved articles.
2848. Onrod Coffeen Evans, M.D., New York—Improvements in digging machinery.
2850. George Gotts Golding, Gray's-inn-road—Improvements in boilers for heating, warming, or raising steam.
2852. James Leitch, 1, Ellenborough-street, Liverpool—Improvements in filtering sugars and other saccharine matters.
2854. Jean Jaques Fontaine, Paris—Improvements in the manufacture of steel.
2856. Andrew Small, Glasgow—Improvements in marine compasses and in apparatus applicable thereto.

Dated 18th December, 1855.

2858. Christian Rudolph Wessel, 25, Fitzroy-square, New-road, and George Bowden, Little Queen-street, High Holborn—Joining elastic webbing into indissoluble bands.
2860. John Pierrpoint Humaston, Newhaven—Improvements in instruments for composing or transmitting telegraph messages.
2862. David Lloyd Price, Beaufort, Brecknock—Improvements in electric telegraphs and in appliances connected therewith as applied to railway-trains and fixed stations.
2864. Hiram Hyde, Truro, Novo Scotia—Improved mode of purifying alcohol or alcoholic spirits. (A communication.)
2866. Edward Davis and John Milne Syers, Liverpool, and Charles Humfrey, Camberwell—Improvements in distilling resinous, bituminous, fatty, and oily matters, and in the treatment of certain products therefrom.
2868. Frederick Robert Augustus Glover, Bury-street, St. James's—Improvements in the construction of breakwaters, sea-walls, and other structures and foundations which lie partially or entirely under water.

Dated 19th December, 1855.

2870. George Ross and Thomas Wilkes, Birmingham—Improved machinery for the manufacture of bolts, rivets, spikes, screw-blanks, screws, nuts for screws, and washers.
2872. John Henry, Frederick John, and Charles Staunton Hadden, Nottingham—Improvements in circular frames for the manufacture of ribbed fabrics.
2874. Henry Robert Abraham, 11, Howard-street, Strand—Improvements in carriages, and in certain appurtenances and appendages which belong to those used as hospital conveyances or ambulances.

Dated 20th December, 1855.

2876. Robert Walker, Eccleston, near Prescott—Improvements in applying power to and in machinery for raising and lowering coals and other articles from and into mines.
2878. Andrew Shanks, 6, Robert-street, Adelphi—Improvements in instruments for indicating pressures.
2882. George Tomlinson, Bousfield, Sussex-place, Loughborough-road, Brixton—Improvements in machinery for splitting leather. (A communication.)
2884. John Barcroft, Hanley, Stafford—Improvements in the materials to be used in the manufacture of baskets and basket-work.
2886. Louis Rudolph Bodmer, 2, Thavies-inn—Improvements in hydraulic seed-crushing machines or oil-presses.

Dated 21st December, 1855.

2888. Jean Baptiste Emile Saffroy, Bordeaux—Improved break for railway-carriages—(A communication.)
2890. Thomas Edward Merritt, Maidstone—Improvements in breech-loading ordnance and fire-arms.
2892. Matthew Tomlinson, Ivy-house, Culcheth, Lancaster—Improved medical plaister.
2894. James Murdoch, 7, Staple-inn—Improvements in machines or apparatus for working chain stitch embroidery. (A communication.)
2896. Henry Francis, 456, West Strand—Improvements in apparatus for cutting out parts of garments.
2898. William Joseph Curtis, 1, Sebbon-street, Islington—Improvements in fog signals, and in laying the same upon the rails of railways.

Dated 22nd December, 1855.

2900. Myles Kennedy, Ulverstone, and Thomas Eastwood, Preston—Improvements in pump buckets, which improvements are also applicable to lift-pumps, air-pumps, and all similar apparatus.
2902. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in furnaces for steam-boilers and other heating purposes. (A communication.)
2904. Christopher Dresser, Waterloo-cottage, Waterloo-street, Hammersmith—Improvements in the mode of effecting what is called "Nature printing."
2906. Edward Rowcliffe, 2, Gloucester-terrace, West-grove, Blackheath—Improvements in the manufacture of blocks or slabs for paving or building purposes.
2908. David Dick, Paisley—Improved regulator for gas.

Dated 24th December, 1855.

2910. Frederick Holdway, 12, Mount-street, Grosvenor-square—Improvements in carriages and various parts of the same.
2912. Thomas Cowburn and George Walker Muir, Manchester—Improvements in steam-boilers, and in valves and parts connected therewith.
2914. Christian Ernst Offhaus, Newark, U.S.—Improvements in rotary steam-engines.
2916. John Barton, Stockport—Improvements in shuttles or shuttle-tongues.

Dated 26th December, 1855.

2918. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improvements in railway axle-boxes. (A communication.)
2920. John William Lewis, Manchester - Improved picker for looms.
2922. Sylvanus Sawyer, Massachusetts, U.S.—Improved bomb-shell.
2924. David McCullum, 3, Victoria-place, Stonehouse, Improvements in electric telegraphs.

Dated 27th December, 1855.

2926. Simon Petit, Versailles—Improved apparatus for buoying ships or vessels, and also drawing them out of water.
2928. Alfred Krupp, Essen, Prussia—Improvements in guns and gun-carriages.
2930. Edwin Ladmore, Birmingham—Improved method of securing ramrods to military fire-arms.
2932. John Grist, Islington—Improvements in machinery for the manufacture of staves and parts of casks, and for forming them into casks, barrels, and other like vessels.

Dated 28th December, 1855.

2934. John Robinson, and Richard Cunliffe, and Joseph Anthony Collet, Atlas Works, Manchester—Improvements in locomotive steam-engines, and in springs for locomotive steam-engines, and other purposes.
2936. Thomas Fielding Uttley, Mytholm Royd, York—Improvements in the mode of applying fusible plugs to steam-boilers.
2938. George Chisholm, St. John's-square, Clerkenwell—Improvements in the manufacture of artificial manure.
2940. Henry George Baily, Vicarage, Swindon—Improvements in machinery for digging and forking land.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2835. Ebenezer Rogers, Abercarn—Improvements in safety doors for mines.—15th December, 1855.
2880. Dundas Smith, Porteous, Paisley—Regulating the pressure of gas, steam, water, or other fluids.—20th December, 1855.

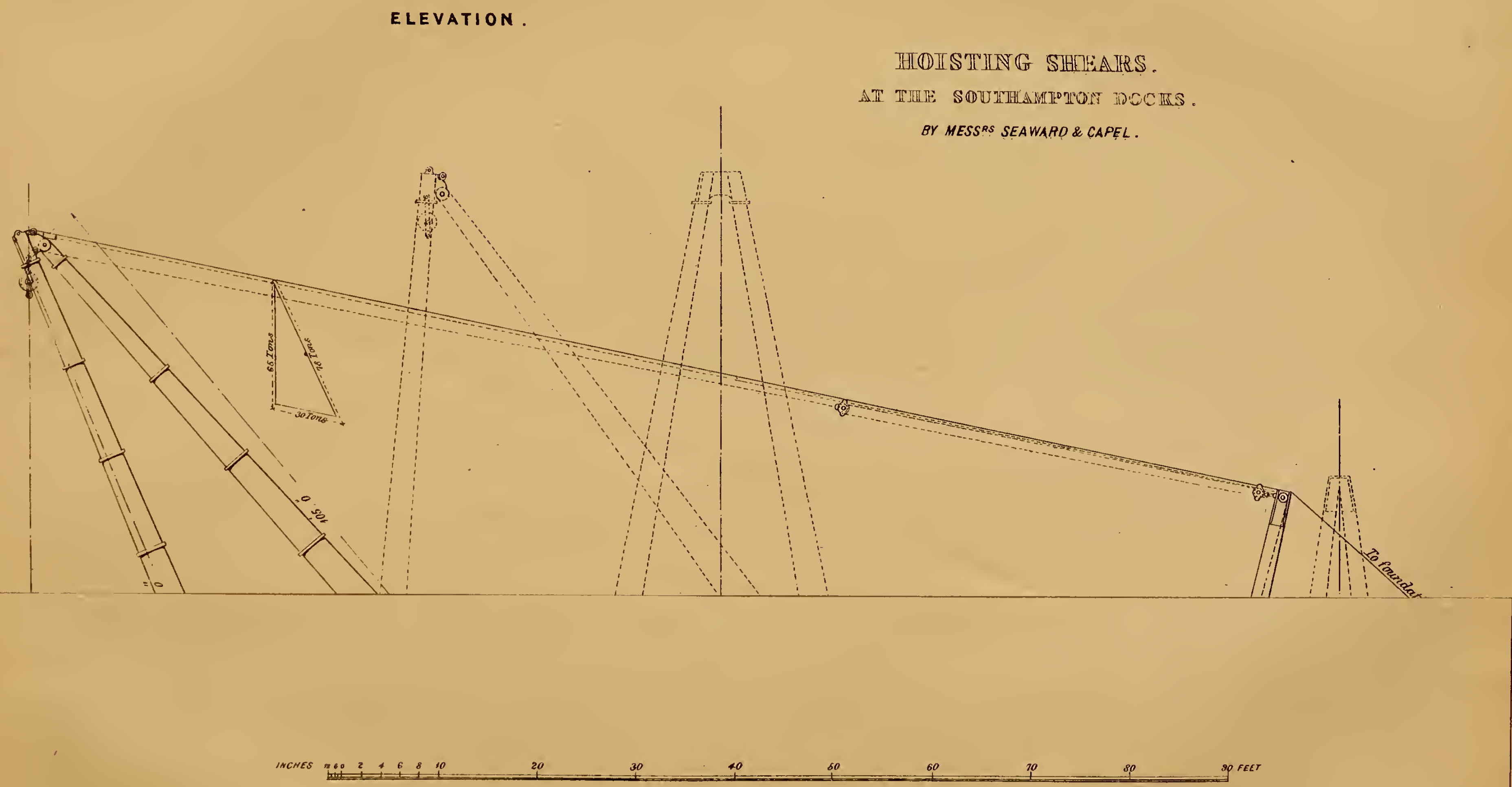
DESIGNS FOR ARTICLES OF UTILITY.

1856.
Jan. 3, 3801. John Jobson, Litchurch Works, Derby, "Joints or Connections for a Stove."
" 3, 3802. Edward Davis, Leeds, "Pressure-Gauge."
" 16, 3803. Richard Frost, 8, Wilson-street, Gray's-inn-road, "A Swivelcal Screw Barrel Tilt."

HOISTING SHEARS.

AT THE SOUTHAMPTON DOCKS.

BY MESSRS SEAWARD & CAPEL.



W. Smith, C. E. Direxᵗ

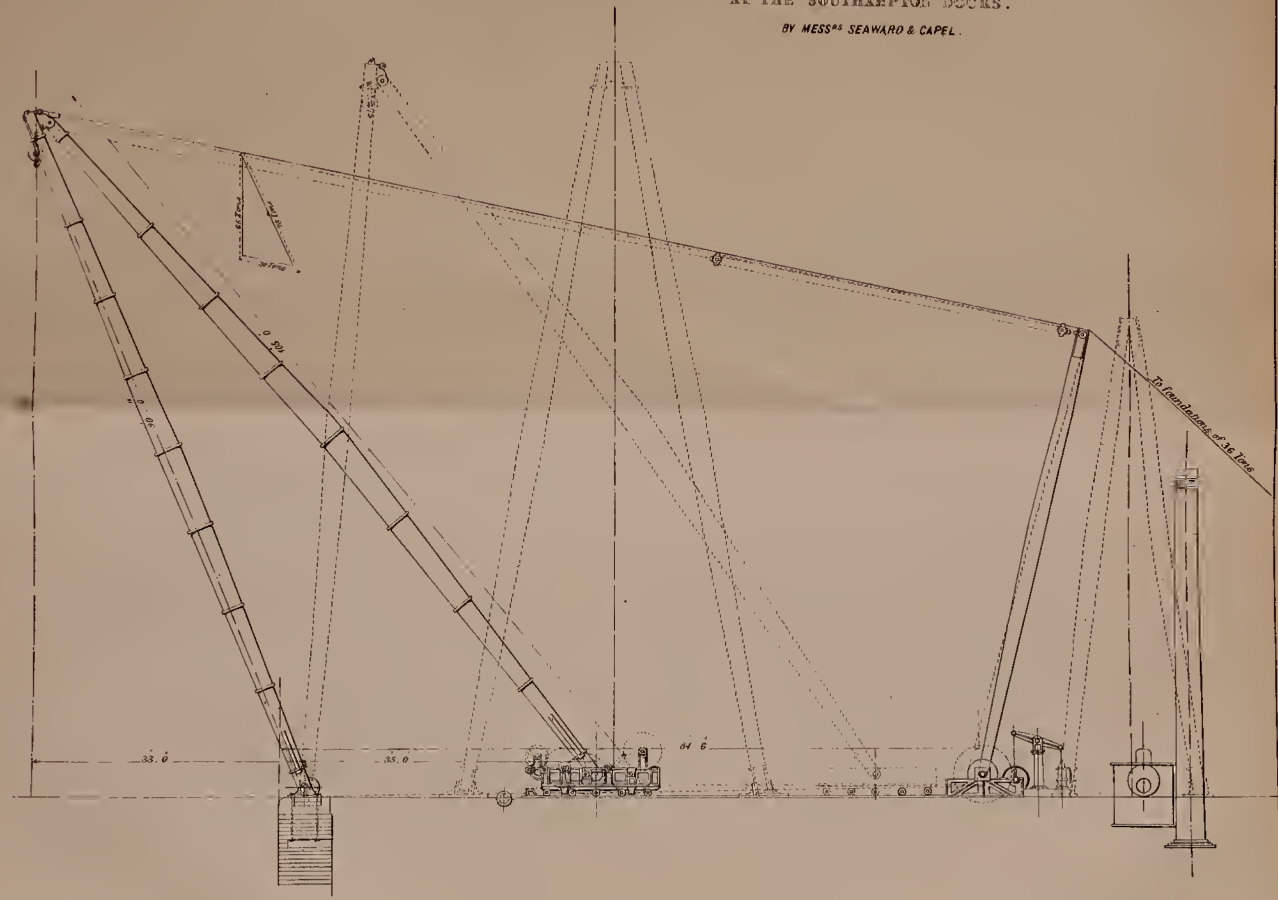
C. Chabot Zinco

HOISTING SHEARS.

AT THE SOUTHAMPTON DOCKS.

BY MESS^RS SEAWARD & CAPEL.

ELEVATION.



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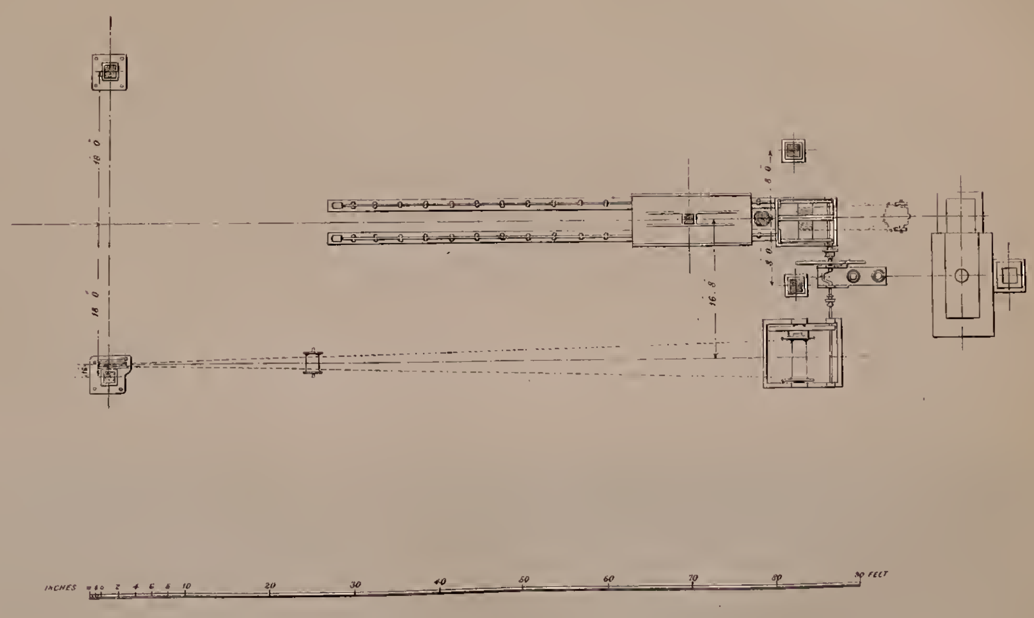
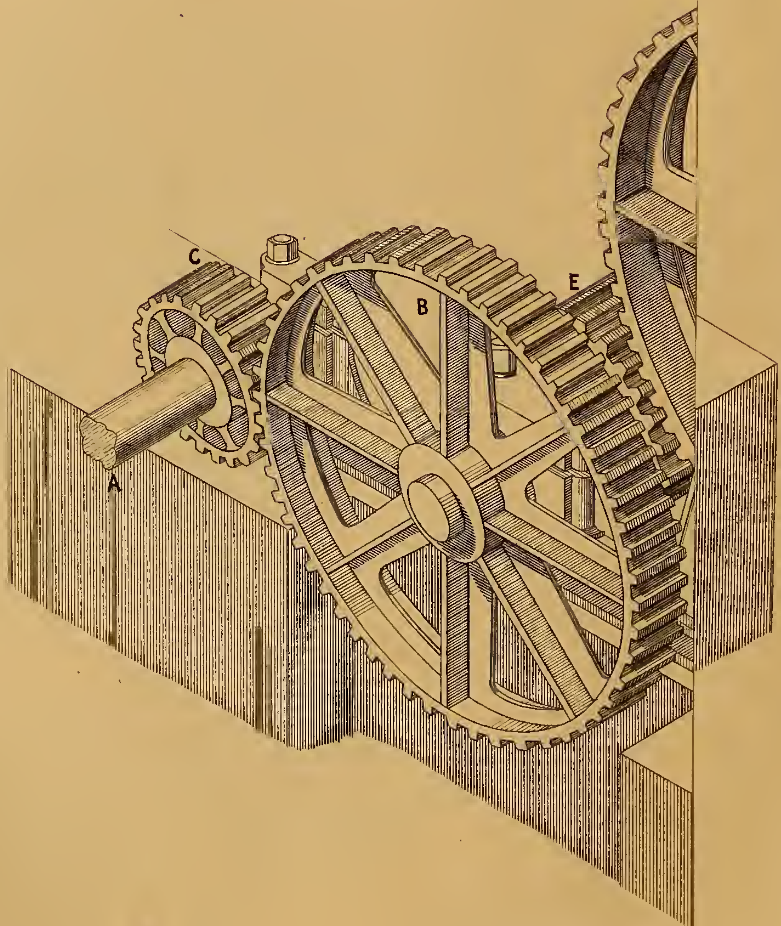


J. & A. BLYTHS'

IMPROVED SUGAR MILL.

WITH UNIFORM ADJUSTING APPARATUS.



Wm. Smith C.E. direxit

J. W. Lowry fc

THE ARTIZAN.

No. CLVIII.—Vol. XIV.—MARCH 1st, 1856.

PRACTICAL RESULTS OF THE SCREW AS A PROPELLER.

We have felt, in common with almost every practical engineer actively engaged in the fitting and equipment of our *steam marine*, whether for purposes of passenger or other traffic, or for purposes of war, that we have still much to learn respecting the screw, and all the elements of a vessel thoroughly adapted for the screw-propeller.

The varying and often contradictory results which we have noticed in our own experience have led us into the conviction that our data and conclusions are still incomplete. It is very much to be desired that the experience and results of our screw steam marine, at present detached, uncondensed, and incomplete, had some focus to draw them together for the general use of science. Some of our scientific societies should take up this subject, and induce the various steam-shipping companies to register and send them in their results,—the facts relative to the dimensions, form, &c., of the vessels; the particulars of the screw-propeller, engines, boilers, &c.; a registration of all trials, especially where different screws have been tried in the same ship. Such matter would, we doubt not, be cheerfully contributed, and if carefully collated and tabulated would be of immense service as data for onward progress.

We need hardly remind our engineering readers that the laws of nature are fixed and unalterable, that the best form of a ship, the best position and relative proportions of a screw propeller for any particular ship, are also to be found only by careful study and observations.

It is, in our opinion, very much to be deplored that there is a greater desire amongst many designers to be known as *original* in their works, when it would be very much more to their credit and reputation to be good copyists. The true and simple laws of nature cannot be departed from with impunity.

We have often regretted that the published trials of many screw ships in the mercantile navy have been, for some special purposes, got up under the auspices of some new or peculiar patent propeller. We have also seen so much of the *cooked* results at such trials, that there are but few which appear in the newspapers which can be depended on.

We would again remark that so much depends upon local circumstances, such as the state of the weather, the tide, the management of engines and boilers during the time of trial, that great caution is necessary before coming to dogmatic conclusions.

In our last we advocated the introduction of coarse pitch screws. We find, on looking over our notes, that we have some strong proofs to urge in favour of this theory. We shall, however, in this paper make a few remarks on the best form of the ship's after-body,—that it should be as fine as possible, so as to give a free ingress to a solid column of water for the screw to act on.

We shall take an example from the table of results of the screw steam ships of the Royal Navy, published by the authority of the Admiralty. Our example shall be Her Majesty's screw steam frigate, the *Dauntless*. This vessel was designed and built by Mr. Fincham for a full-powered steam-ship, at a time when the properties required for a large ship were but dimly appreciated.

Tonnage was originally	1,497 tons.
H.P., nominal	580.
Immersed midship section	522 sq. ft.
Displacement	2,240 tons.

When she was first tried she was jury-rigged, and ballasted to trim; her speed was only 7·366 knots per hour. With this proportion of power to tonnage and speed, it was very evident that there was some malformation and a great waste of power somewhere. It was then determined to lengthen and fine her after-body. Ten feet were put into the stern. The foremost post in the wake of the screw was, in consequence, very much finer. The results were very surprising. In fact, we think it is one of the best examples which have come under our notice. The following figures will show very clearly the *case* of the *Dauntless*:—

H.M. SCREW STEAM FRIGATE "DAUNTLESS," 33 GUNS, 580 H.P.

Dimensions, &c.	Before Alterations.	After Alterations.
Length between the perpendiculars	210 ft.	218 ft. 1 in.
Breadth, extreme	39 ft. 9 in.	39 ft. 9 in.
Mean draught at the time of trial	16 ft. 4 in.	16 ft. 4 in.
Area of immersed midship section	522 sq. ft.	522 sq. ft.
Displacement at time of trial	2,240 tons.	2,251 tons.
Tonnage, Builders' old measurement	1,497 tons.	1,569 tons.
H.P., nominal	580.	580.
H.P., indicated	811.	1,218.
Diameter of screw	14 ft. 8 in.	14 ft. 8 in.
Pitch of screw	18 ft.	18 ft.
Length of screw	3 ft.	3 ft.
Revolutions of screw	55·3.	68·28.
Slip of screw, per cent.	24·97.	15·09.
Immersed section to screw's disc	3·09.	3·09.
Indicated H.P. to section	1·55.	2·3.
Screw's pitch to diameter	1·22.	1·22.
Speed per hour	7·366.	10·293.
Revolutions of engines	24·3.	30.

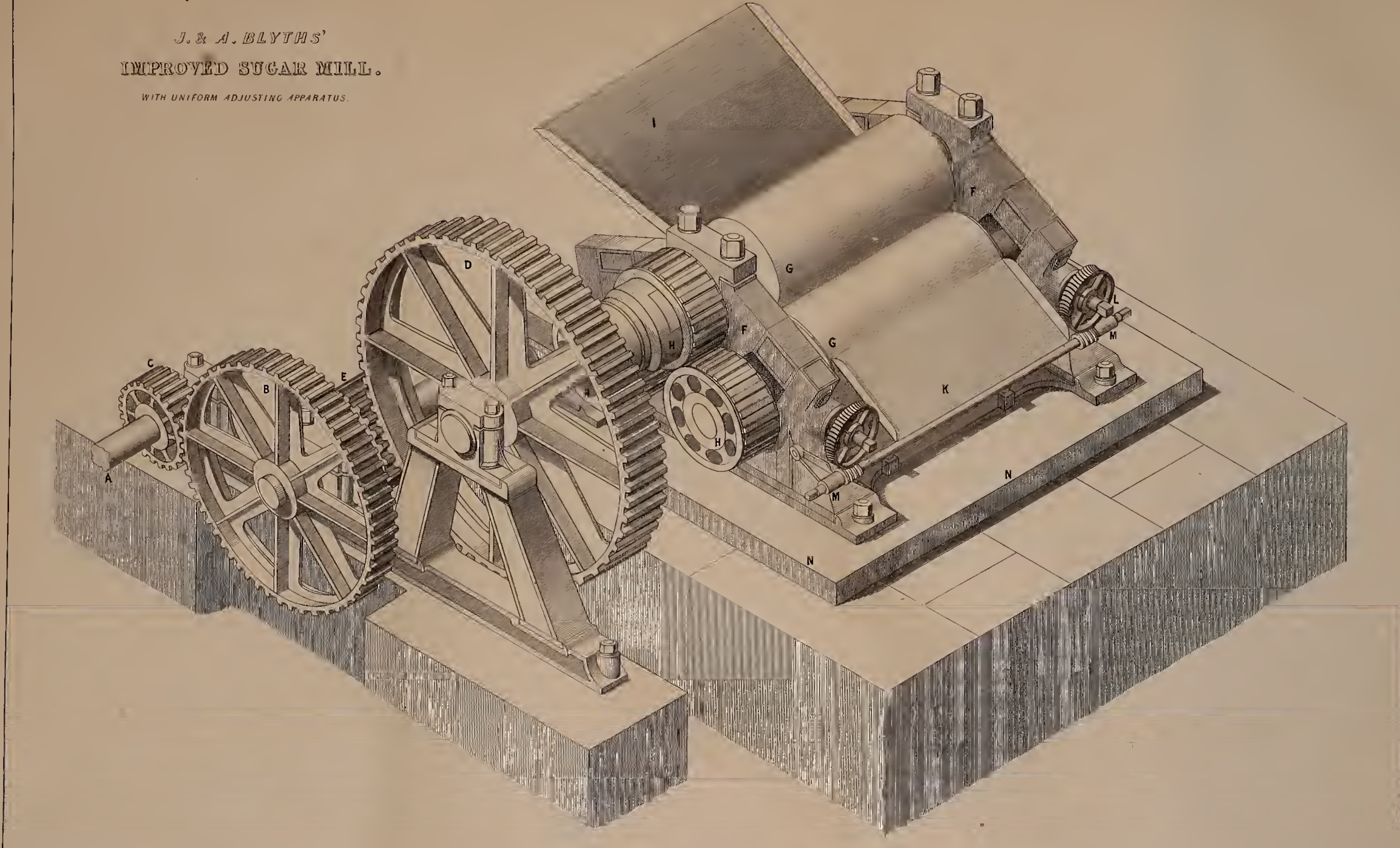
It will be seen by the above table that the broad and striking facts of this case stand thus:—That by lengthening the after-body and reducing the bluff end of the stern immediately before the screw, with the same engines and boilers, the speed of the ship was increased 3 knots, or from 7·3 knots to 10·2 knots per hour; the indicated H.P. raised from 811 to 1,218; the slip reduced from 24 to 15 per cent.; the immersed midship section being the same in both trials, and the displacement only increased 11 tons. The indicated H.P. to section being in the first instance 1·5, in the second trial 2·3.

The professional reader will also be struck, in carefully looking over our table, with the low proportion of indicated H.P. to the nominal H.P. This gives us a chance to fling another stone at the geared engine.

The engines of the *Dauntless* are geared, and made by Mr. R. Napier, of Glasgow. They are strong and substantial we doubt not; but we can only say that, judging by the results as published in these tables, they are not in the *right* place. Better results can now be obtained with boilers of the same size from a pair of 400 H.P. *direct* engines, with about half the weight of metal to carry.

J. & A. BLYTHS' IMPROVED SUGAR MILL.

WITH UNIFORM ADJUSTING APPARATUS.



Wm Smith C.E. delt

J. W. Lowry fc

ON THE SUPPLY OF WATER TO TOWNS AND CITIES.

(Continued from page 27.)

The results will be still more striking if we take higher rates for the tariff; for example, suppose 48s. per ton gives a sale of 900 tons, and, consequently, a receipt of £2,160; or, suppose 56s. a ton gives a sale of 800 tons, and a receipt of £2,240.

This example illustrates the adverse relations that exist between the water companies and the consumers, whenever there is a monopoly. We have endeavoured to treat this as a general question in various articles of the "Annales des Ponts et Chaussées," in relation to the subject of Tolls on Highways. In this, as in every other public measure, whenever there is a monopoly the mischievous effects are visible. We have there demonstrated that each variation of the tariff gives a certain profit to the monopolist: that this profit, which is *nil* for a very high rate, increases in proportion as the rate diminishes up to a certain point, where it attains its maximum, and then decreases indefinitely. The lower the tax is, the more useful or the less injurious it is to the public. These results are very apparent in the distribution of water, for when the rate is high a less quantity is sold, and much is allowed to run to waste that would have found purchasers at a cheaper rate. This may be said of the same things applied to other uses, and not only for different consumers, but for the same consumer, according to the quantity. When water is dear, even the rich economise it.

What has been done at Toulouse is a confirmation of these principles. The price of water has been fixed at £8 a ton, whilst the cost of providing the water is really only 12s. per ton (£2,400 for 4,000 tons a day); charging at this price, the Municipality makes an income of £296, that is to say, they sell 37 tons a day or, less than the 100th part of the water raised. We must say this is a complete failure, both in a fiscal and commercial point of view.

"At the commencement," says M. Daubuisson, "the proprietors of large houses nearly all wishing to be supplied with water, measures had been taken to accommodate them. But when the water was brought nearly to their doors in abundance, and quite fresh, sufficient in quantity to supply all their wants, without the expense and trouble of laying down pipes for themselves, they became indifferent on the subject of having it brought actually into the houses." The number of places to be gratuitously supplied must be considered in fixing the tariff. Now, to sell at Toulouse, for 4s., the same quantity that costs 1s. in Paris, a rich and luxurious town, is not the way to overcome the difficulty. Nevertheless, the 4s. tariff has found a certain number of purchasers; 3s. would have found more, and 2s., or 1s. more still. Now, what becomes, at Toulouse, of the water which is not sold? A resolution of the authorities, on the 26th July, 1826, answers this question. All the water which is not sold, agreeably to the first article, that is, at the price of 16s. a year for 22 gallons per day, shall be carried out and poured upon the streets and public places. In this way they waste a large portion of the water, which costs only about 1s. 2d. for 22 gallons, and for which people would willingly pay 4s., 8s., or even 12s.; and they prefer to pour it into the gutters rather than sell it at these prices. How can such folly be justified? If they say that at so low a price the demand would be too great, and there would not remain enough for public use, we answer that there can be nothing to fear by selling for 4s., 8s., or 12s., that which costs less than 1s. 3d., seeing that, with such demands, it is always easy to augment the production. If it be said that lower prices would increase the consumption but diminish the receipts, we answer, first, that this is not probable; and, further, with a well-graduated tariff, it is not possible. This we will endeavour to show. We must first usefully employ all the water that is provided, and indemnify the company for the expenses incurred. We have just seen the consequences of an invariable tariff, framed simply for the sale of water according to the quantity. The results are not the same when the water is sold without restriction as to quantity, and when different classes of subscribers are admitted.

Let us suppose that all the inhabitants of a town declare conscientiously the maximum price they will consent to give for an unlimited supply of water. In framing a tariff on such data the company would receive the largest amount possible, as the whole of the water would be used and paid for, and the receipts would much exceed the amount expended. But if, instead of collecting the entire sum from the inhabitants, only a fraction, as the fourth, or the third, or the half, were demanded,—in fact, as much as will pay the company's expenses, it is still evident that no waste of water would be incurred, and that the gain from the lower price will be equally divided between the company and the consumers. An unlimited supply of water ought then to be provided, at a price in accordance with its advantages. There are many difficulties in applying this principle, and we have no other motive than the wish to point out the best means to solve the problem. To supply water in unlimited quantity might lead to a greater consumption than the company have at their disposal; but this would only prove that a wrong calculation had been made in the beginning, and that it is necessary to increase the supply. But this is a rare case. In all new works it is not the water that fails, but the consumer, and often on account of the rates charged.* At Paris, for instance, the lowest rate fixed is £3 a ton; it is, therefore, clear that the town loses the benefit of those who can only afford lower rates than this. Out of 21,000,000 gallons a day, which is raised by the company of the Canal de l'Ourcq, only one-half is consumed; every day 10,000,000 gallons of water are lost to the company and the consumers. We say also that an unlimited supply of water would increase its *use*, and not its *abuse*, as some imagine. Besides, it is not a new and untried method; both in Paris and in London there are thousands of consumers *à discretion*, and we know that in Paris the abuse of this privilege is very rare. The possibility of giving unlimited supply can no longer be called in question, since the practice exists in certain towns, and it only remains to fix the basis of charge, namely, whether the quantity consumed is to be considered, or the benefits it affords. In Paris the former is universally considered, and we think the custom vicious; in London, and other English towns, the benefit conferred is more especially considered in fixing the charge, which we think an improvement on the Paris custom.

It is difficult to know what sacrifices the consumers would be willing to make to obtain water, and to fix the price accordingly; but we do not think this insurmountable. There are many outward symptoms which will help us to conjecture, with sufficient exactness to found our speculations upon. It is clear that a householder will consider the number of his family, the nature of their occupations, and the difficulty of procuring water. These are data or statistics quite open to all the world, and may be ascertained without any inquisitorial proceedings. Thus, in certain English towns, the water-rate is regulated by the rent of the houses, and descends gradually, till it is within the reach of those who could not afford the higher charges. This is a first step in the right direction;—we must take many others. Could we not arrange houses into classes, as we divide the carriages on a railway? If all the railways had only one class, what a loss would it be to the public and to the companies.

The framing of a tariff for the sale of water is, in our opinion, a local study; a tariff suitable for one town would be inapplicable to another. Imagine a town, situated on an eminence, and the only means of obtaining water that of procuring it from very deep wells, and this water of bad quality; it must necessarily be sold dearer than in another town where the water is superior in quality and more easily procured. One of the obstacles to the sale of water is the gratuitous distribution of it, by means of public fountains, as at Paris. Several towns in France have no other means of distribution. We need only remark, on this

* The failure of water may be a rare case in France, and that of consumers a frequent case; but in England it is commonly the reverse. M. Dupuit has not so much acquaintance as we on this side of the water with towns which have risen, within a few years, from villages into cities of 60,000 or 70,000 inhabitants. In our manufacturing districts he would find many such towns, where the water fails, where the sources of supply are altogether inadequate, and where the inhabitants are loudly lamenting the insufficient supply.

system, that its partisans are mistaken if they think it an advantage to give water gratuitously. The State or the Municipality can furnish nothing without payment, except on the condition of charging more for other services. Thus, in the example quoted above, where a town had spent £40,000 in procuring a supply of water, it is clear that if this had been done gratuitously, the town must have paid, in some form or other, both the interest of the money and the cost of maintaining the works. Its *octroi* taxes must have been increased, or some new taxes imposed; in short, whatever the measures resorted to, one thing is certain,—the water must be *paid for*.

We need not expatiate longer on this subject; we only wish to draw attention to the questions it raises, and which belong rather to political economy than to the business of an engineer.

BLYTH'S IMPROVED SUGAR-CANE CRUSHING MACHINERY.

We this month present to our readers an engraving of a very powerful rolling mill, newly constructed, for the crushing of sugar canes in the colony of Mauritius. The rollers of this mill are 5 ft. 6 in. long, and 2 ft. 6 in. diameter, and are driven by a very powerful high-pressure steam engine, being connected thereto by gearing of great strength, giving the mill rollers a speed of about two revolutions per minute. This mill will introduce to the sugar-planter an improvement of very great importance and of the highest utility, the rollers being provided with a simple mechanism, whereby the two ends of each side roller are set up with exact equality by one manual operation; and when the most advantageous adjustment has been made the rollers are, by the same mechanism, retained in that position with a firmness and security afforded by no other means, and improper interference with the adjustment is effectually prevented. The utility of this addition to the sugar mill will be appeciated by those who, from practical experience, know that the unequal adjustment of the mill rollers is attended with serious evils, the loss of juice from imperfect pressure of the canes, and damage and breakage of the mill pinions from the immoderate strain thrown upon one end. The new arrangement will obviate these evils, the strain upon the rollers will be equalised, and the whole body of canes passing through the mill will be subjected to a uniform and perfect pressure which cannot but tell most favourably upon the amount of juice produced, when it is considered that, whilst many mills of ordinary construction obtain only 45 to 55 lbs. of juice from 100 lbs. of canes, the best mills with proper care in working obtain 70 to 75 lbs.

The massive character of Messrs. Blyth's mill may be judged of from the fact that the total weight exceeds 70 tons, and its immense strength, and general excellence of construction, will add to the high reputation which the makers have enjoyed for many years in the Mauritius and the other sugar colonies.

A weekly contemporary, devoted to scientific subjects, contains the following remarks upon Messrs. Blyth's mill, which we quote with pleasure *:—

"In the brief article referring to Blyth's sugar mill in the 'Engineering Journal' of last Saturday, I scarcely think the saving effected by the machinery is made sufficiently clear and prominent. The great purpose of a sugar mill is to express the juice of the cane completely. This has never been done by the class of mills formerly in use, and to a certain extent in operation now. In these mills the dry cane is retained by centripetal force on the roller, the revolution being too rapid to prevent a defect so serious. In Messrs. Blyth's mill the speed is reduced without any diminution in the quantity passed through the roller in a given time. This result is produced by a greatly improved construction and increased power. The mill for the Mauritius, noticed in the last number of the 'Engineering Journal,' would appear to defy derangement, so gigantic are its parts and so nicely adjusted in their various proportions. The salient feature of this improved mill is undoubtedly the adjusting apparatus applied to the lower rollers. There could scarely be a more scientific contrivance for preventing derangement whilst the machinery is in motion. Our sugar-growing colonies will benefit largely by this substantial and economical improvement in machinery which, in a few years, will no doubt supersede the old class of mills wherever they are employed. Being interested in sugar property, which of late has sustained such serious deterioration, I thought I could not better serve the cause of economy and science than by noticing the extreme value of Messrs. Blyth's improvements."

With reference to the Plate, A, is the crank-shaft of the steam-engine; B, and C, the 1st wheel and pinion; D, and E, the 2nd ditto; F, F, a strong girder and frame, upon which the bearings of the shafts revolve, and by which the exact centres are preserved; G, G, G, the rollers of the mill; H, H, H, connecting-gear, by which the motion of the top roller is communicated to the two lower ones; I, the feeding table, upon which the canes are placed, and from which they are drawn on between the rollers; K, the delivery-plate, which guides the exhausted canes out of the mill; L, L, the set screws, by which the front roller is adjusted to the exact pressure required; M, M, a cross shaft connected to these set screws, and by which they are equally adjusted; N, N, the bed-plate of the mill, which serves also as a cistern to collect the expressed juice and discharge it into a reservoir.

* From the "Engineering Journal," of 26th January.

SOUTHAMPTON DOCK SHEARS.

We have been requested by numerous subscribers to furnish illustrations and particulars of these justly-celebrated shears, and are now enabled, through the courtesy of Messrs. Seaward, the designers and manufacturers, to accede to their wishes.

We present our readers with a plate (No. 67), exhibiting these shears, accurately drawn to scale; the principal dimensions, the angles, working positions, and strains,—indeed, every material part for the use of the engineer being correctly put in. To treat of the subject as completely as possible, and to exhibit the shears in action, without encumbering the figures in the plate, we have had carefully drawn and engraved on wood, a side elevation of these shears as seen when lifting a boiler. The letters of reference given belong to the general view on wood block, and the description of the apparatus applies to the plate and the woodcut.

The peculiar features of these shears consist in the third leg, A, A, by which a weight, when lifted out of the vessel, can be brought in and landed on the dock wall, or on a railway-truck, or *vice versâ*. As a proof of the facilities afforded, we may state that a pair of boilers of 200 H.P. were lately slung in the vessel, lifted and landed, and the vessel sent away,—in two hours.

The present shears are the second which have been erected on the site, the former ones having fallen in with the dock wall, in January, 1854, in consequence of the wall slipping on its foundations. The present wall stands upon rubble masonry, below that concrete, with a gravel bottom.

The proof-strain to which they were subjected was 50 tons, but their ultimate strength is much higher. The legs are single sticks, by Ferguson, mast-maker, of Millwall, London, and are splendid specimens.

The high-pressure engine, the fly-wheel of which is marked B, is used for hoisting heavy weights; a pinion, keyed on its crank-shaft $7\frac{5}{8}$ in. diameter, gears into a wheel of 7 ft. 3 in., the shaft of which has the chain-barrel 18 in. diameter × 5 ft. long between flanches. The above wheel and pinion are $2\frac{1}{8}$ in. pitch × $6\frac{1}{2}$ in. face.

The chain on this barrel is a $\frac{3}{4}$-in. short-link chain, and is guided on its passage to the leading pulley at the foot of one of the legs by a wood end shoot, and so passes over the leading pulley to top blocks at shear head.

These blocks have each six sheaves, and as the power gained by the pulley-blocks is as double the number of moving sheaves, the purchase in this case is twelve to one, and this, again, is greatly multiplied by the wheel and pinion mentioned.

It will be seen, by our sketch, that the foot of the third leg, A, A, is attached to a frame, which carries three distinct trams of wheelwork, viz.:—

No. 1, for lifting heavy weights by manual power, and which, before the addition of the steam-engine, was constantly at work. It consists of a pair of handles 18 in. radius.

Pinion on first motion or handle-shaft has 14 teeth, and works into wheel of	130 teeth
Pinion on second motion-shaft	15 „
Works into a wheel on barrel-shaft, which has	101 „
Radius of chain-barrel	9 in.

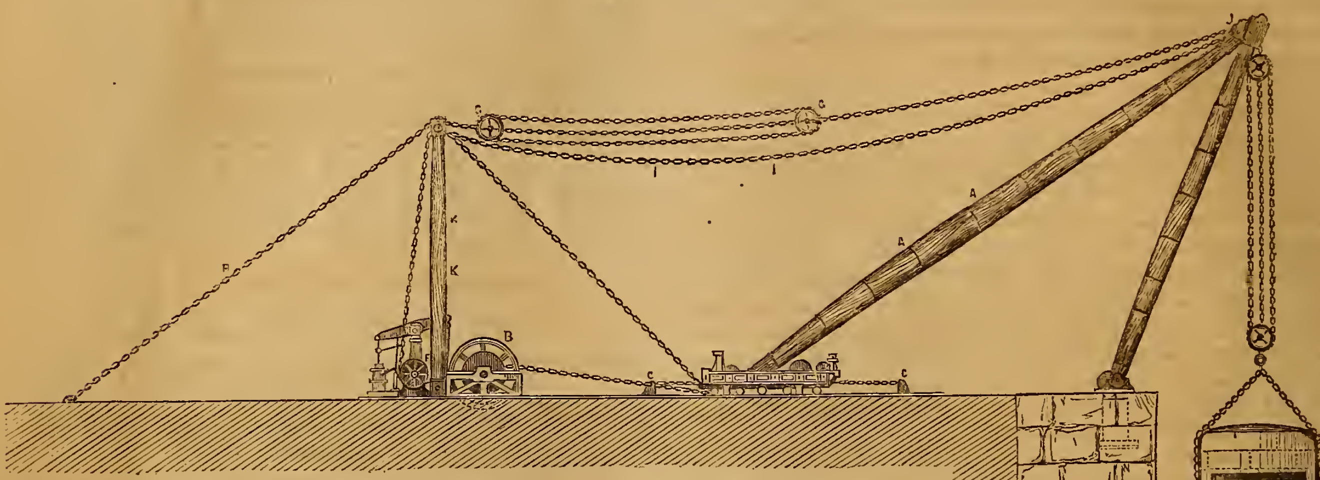
So that, supposing eight men at the handles, each exerting a force of 30 lbs., we have

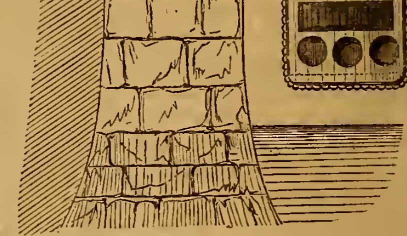
$$\frac{\overset{\text{Tons.}}{130} \times \overset{\text{in.}}{101} \times 18 \times 8 \times \overset{\text{lbs.}}{30}}{14 \times 15 \times 9} = \overset{\text{Tons.}}{13{\cdot}3} \times 12 \text{ for blocks} = \overset{\text{Tons.}}{159}$$

gross power exerted, which leaves a good margin for losses by friction, and tired or lazy men.

No. 2 is for lifting lighter weights, and is connected with a pair of

SOUTHAMPTON DOCK SHEARS.





three-sheave blocks, which hang side by side with the larger ones, the purchase of these being proportionately less.

No. 3 is for moving the frame-work and foot of third leg, A, A, along the tram-road. The frame runs upon friction-rollers, connected together by a bar at their axles to ensure their moving together, and the movement is effected by a strong chain, which passes for three or four turns round the barrel, and has its ends made fast to strong girders, *c*, *c*. When this barrel is set in motion, through the wheels and pinions connected with it, it propels the whole frame in either direction, as the weight lifted may require, to be brought on, to, or beyond the dock wall.

The foot of leg, A, A, is thus moved; and while this is going on, the two winches, F, F, are put in motion for the purpose of moving the head of shears. These winches consist of a single wheel and pinion, with chain-barrels connected together, so as to wind at equal speeds. Their purchase is greatly increased by the blocks, G, G, so that the power required at the winches is small.

It will be seen that, by this arrangement, the back guy-chain, H (which is 1⅝ in. patent link-chain), has no strain on it, excepting when the shears are inclining towards the water, as, when they are perpendicular, or incline towards the quay, the strain is carried by the legs themselves.

There is a check-guy, marked I, I, which connects shear-head, J, J, with small shears, *k*, *k*, and which serves to prevent accident in case of anything going wrong with the winches, and also acts as a stop for shears when they incline over the quay.

The rate of hoisting, of course, depends upon circumstances; but when a boiler, for instance, has been lifted clear of the ship's beams, &c., the engine is allowed to run about fifty revolutions per minute, which gives a speed of about 2 ft. per minute to the boiler which is being lifted—a great contrast to the speed attained by manual power.

In conclusion, we may add, that it is a debatable question whether iron would not have been preferable to wood for the legs, on account of its greater strength and durability. We have seen some fine lower masts of merchant steamers made from boiler-plate, and also, at Nillus's works, at Havre, some good iron shears. When so made, we should recommend an arrangement for an occasional painting inside, and, with ordinary care, we think their durability would far exceed wood or any other material in use.

THE GLOBOTYPE TELEGRAPH.

THE globotype telegraph, invented by David M'Callum, of Stonehouse, Devon, professes to supply a want which has long been felt in telegraphic communication. It must be obvious to all who have made the telegraph a matter of observation, that if the message could be recorded in any tangible form without involving a complication of machinery, or synchronous movements, that such a plan would be sure to supersede those telegraphs which are at present in operation.

The leading characteristic of this telegraph consists in releasing small glass balls, and the apparatus is so arranged as to allow them to fall into a groove over a series of inclined planes, when they immediately roll into their proper places by the force of their own gravity. Fig. 1 represents the box open, in which the globotype telegraph is contained; the side of the box turns down, on which is placed dial No. 1. The alphabet is also shown in three panels on the front. Fig. 2 represents the upper part of the apparatus; C, C, C, are the basins which contain the balls by which the message is recorded. The balls are three different colours—white, black, and blue; they pass into three glass tubes, B, B, B; at the lower end of each of these a detent is placed, E, and Fig. 3, E, E. By the peculiar construction of the detent no more than one ball can possibly be released at once. These balls multiplied and intermixed constitute the alphabet: they are thrown out one by one at the will of the operator into a receiver, Fig. 3, F, then they pass down an incline into a brass tube, G, through which they fall into the dial, and in this way the message is recorded. The dial is composed of a series of inclined planes, over which a plate of glass is placed.

There is no clock-work which requires to be wound up,—no pencils to be mended,—no paper to be prepared, or the movements of a needle to be watched,—there is not a single spring or a wheel in the whole construction, yet the messages are recorded with the greatest certainty, and with as much facility as any other telegraph, and on long distances will exceed the most of them, because there is no necessity for the clerk to wait for a single word before he may begin to forward the message, for as soon as a ball makes its appearance in his own dial, he has only to touch a key* which corresponds with the colour of it, and a similar coloured ball is instantly released at the next station, and this may be continued over any extent of country. The clerk may send the message in this way with greater facility than if he sent it from the written document.

In this manner, also, secret communications may be transmitted. It is only to state or write what coloured balls are required to record the message, and the clerk will forward it quicker than he could from a plainly-written paper with which he was quite familiar.

This telegraph may be worked with one or two wires, with magnetised bars, or electro magnets. The model, which is partly represented by the above engravings, is worked on the principle of two wires, but every argument is in favour of one, and one wire is therefore particularly recommended.

For further information a pamphlet is in course of publication, in which every part of the apparatus is described. It will contain nine wood engravings, the price is one shilling, and may be obtained of the Publishers, Messrs. Longmans and Co., Paternoster-row, or of W. Brendon, George-street, Plymouth.

The above invention is now being patented for the United Kingdom and several countries on the Continent.

* Fig. 1, N. Section also shown in Fig. 3.

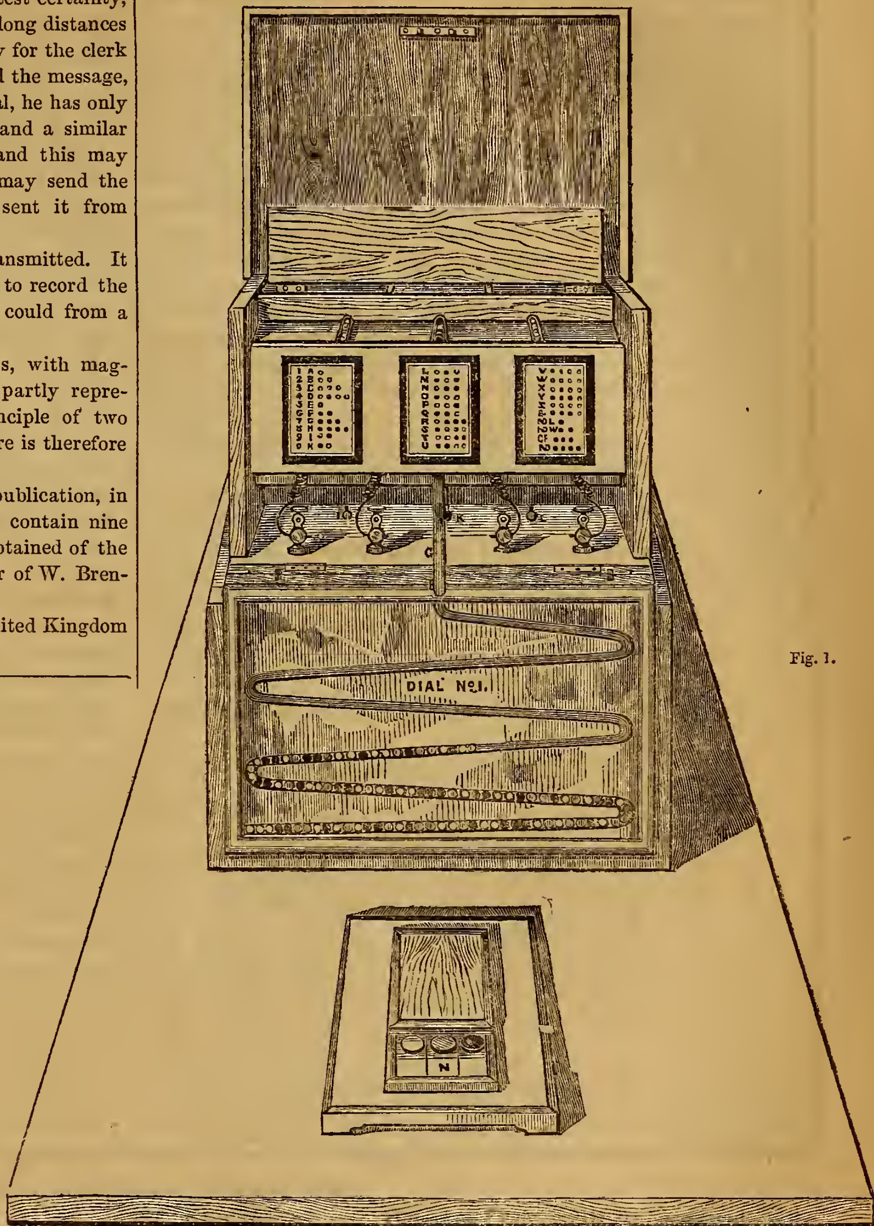


Fig. 1.

Fig 3.

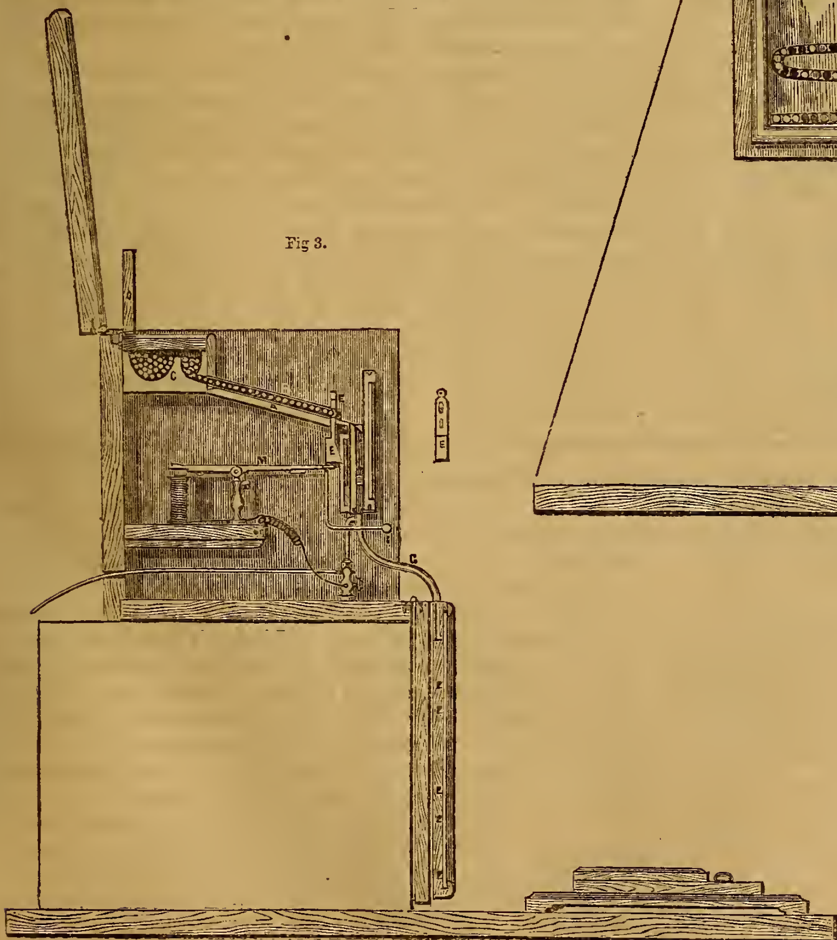
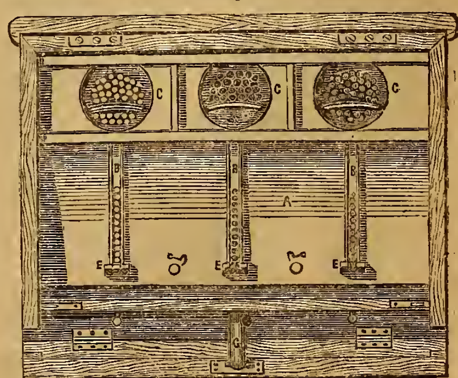


Fig. 2.



THE GLOBOTYPE TELEGRAPH.

MEMOIR OF MR. GEORGE WHITELAW.

During the last year the mechanical world has sustained a severe loss in the death of Mr. George Whitelaw, of Glasgow, an engineer of great originality and eminent scientific and practical attainments, but as modest and retiring as he was skilful and successful. Mr. Whitelaw was the manager of Messrs. Cook's works, in Glasgow, which he conducted with great ability for many years, and never did any one attract to himself warmer friends or pass through life with fewer enemies. The affectionate regard in which Mr. Whitelaw was held by all who knew him is best manifested by the deep and enduring affliction which has been caused to them by his decease—an affliction due partly to their love for the man and partly to the sense of the heavy loss which the mechanical world has sustained by the loss of so eminent a member. On his family and those who daily worked with him the bereavement must of course fall with heavier force than upon less intimate acquaintances; but all who knew Mr. Whitelaw could not fail to love him,—so full was he of talent, of kindness, and of modesty,—and they all participate, therefore, in the deep sorrow which his death excites.

He was the second son of George Whitelaw, brewer, Glasgow, and Agnes Kennedy, and was born in Gorbals, on the 21st December, 1803. After having received an ordinary commercial education, he was employed for a short time in a lawyer's office, where the amount of practice does not seem to have been great, as he was allowed to pass a great part of his time in reading mechanical books obtained from the Andersonian Library, where he had begun to attend Dr. Ure's lectures, and where he acquired the elements of chemistry and natural philosophy, and confirmed the taste he had already displayed for mechanics.

On leaving the lawyer's office he was bound apprentice to the engineering business, with Messrs. James Cook and Co., where, in this congenial pursuit, he soon attracted the attention of Mr. Cook by his aptitude and attention.

During his apprenticeship he still continued to attend Dr. Ure's classes, and seems to have derived great benefit from them, as he always spoke of the doctor with great respect. When about 19 years of age, he commenced the study of mathematics under Mr. Wallace, in the Andersonian Institution, and at the end of session 1824, he took a silver medal for excelling in mathematical exercises. All his life mathematics continued to be a favourite study and amusement.

After the expiration of his apprenticeship, which was for the term of seven years, he went to Leith as the foreman of the Caledonian Foundry. He continued in this situation for about three years, after which he returned to Glasgow, to take a charge in Mr. Cook's, where he remained for six or seven years. About this time he made an improvement in Savary's engine, which he communicated to the Society of Arts, and for which he received their silver medal in 1833. In 1835 he went to Dublin, as the engineer of the Dublin and London Steam Company. He remained nearly two years, and succeeded, in an eminent degree, in obtaining the confidence and respect of his employers; but at the urgent request of Mr. David Cook, who had now succeeded to the business of his uncle, Mr. James Cook, he returned to Glasgow to become Mr. Cook's manager, in which capacity he continued till 1846, when Mr. D. Cook retired with a large fortune. He then entered into a ten years' partnership with Mr. R. Cook and Mr. Barr, to carry on the works on their own account, which contract he was not destined to complete, as he died on the 30th June, 1855, the very last day of the ninth year of his copartnery.

His disease was an affection of the kidneys of long standing, which troubled him occasionally, and caused him to be very abstemious in his habits; still, from his quiet and careful way of life, he enjoyed tolerable health till within about two years of his death, when the symptoms became much worse, and at times he suffered great pain. The summer before he died he appeared to rally, but upon the approach of winter he became worse than ever, and began to exhibit symptoms of a general breaking up of the system. In spring he was removed to Bowling, and from thence to Rothsay, but he continued gradually to sink, till at his own request he was taken home to Glasgow, where, after having borne a long and very painful illness with the patience and resignation of a true Christian, he died, deeply regretted by all who knew him.

Among his miscellaneous designs are a machine for raising water, for which he received the Society of Arts' medal, and of which a drawing appeared in the first volume of The Artizan; a new way of propelling vessels, which was patented, but did not succeed well; a plan of reclaiming mossy land; the principal part of the machinery in Messrs. Doddrell's sugar-house at Port Dundas, &c. His latest improvement was a compound machine for rivetting, cutting and punching iron, which he did not live to see completed. It, however, is now in successful operation and has attracted a good deal of attention; it has been recently patented by Mr. R. Cook, and a description of it has been published in The Artizan.

Mr. Whitelaw's elder brother, Alexander, was editor of the "Casket of Literary Gems," "The Republic of Letters," "The Book of Scottish Song," and other esteemed works.

NEW MARKET, BOLTON, LANCASHIRE.

"It were good that the privilege of a market were given, to enable them to their defence; for there is nothing doth sooner cause civility than many market towns, by reason the people repairing often thither will learn civil manners."

So wrote Spenser, and doubtless he is right; but that a place, from being small, dirty, and ill-conducted, should in a few years rise to be a prosperous, wealthy town, adorned with handsome public buildings, the last-erected of which is one of the best-designed market halls in England, is a reality that, probably, Spenser never even imagined, and which has been left to this busy, steam-working nineteenth century to effect.

The Market Hall of Bolton was opened to the public on the 19th December, 1856; it is not yet quite finished, but the work necessary to its completion will not interfere with business. We have carefully examined the building, and are therefore able to offer the following description of it to our readers.

The building is 294 ft. 5 in. long by 219 ft. 9 in. wide, giving an area of about 7,188 sq. yds. The principal entrance, from Knowsley-street, is a centre portico of the Corinthian order, upwards of 50 ft. high. This portico consists of six columns, supporting a pediment, which have behind them a wall of rusticated masonry, pierced by a wide and lofty archway, commanding the entrance to the market.

The portico is flanked by arcaded wings, connecting it with bold, imposing-looking angle buildings of massive design, which are surmounted by ornamental ventilating turrets. The façades facing Corporation and Rushton streets have a centre of the Doric order, united by similar arcading to wing buildings, alike surmounted by ornamental ventilating shafts; the remaining side, towards the river Croal, has no entrance to break the line of arcading, but, owing to the boldly rusticated basement of unhewn stone on which it stands, has a handsome effect. These are the four fronts of the building, and behind them rise the ornamental gables of the main roof, the whole being crowned by a large and lofty ventilating turret, whose summit is 112 ft. above the market floor. In the interior the building is divided into a nave, transepts, and side aisles, divided from each other by highly-ornamental cast-iron columns and girders, which seem almost countless in number as they recede behind each other, and produce a scenic effect, reminding one of the fabled palace of Aladdin.

The centre portion of the building is a *chef d'œuvre* of cast-iron construction, and shows what this material is capable of when in the hands of an intelligent artist and engineer.

A gallery, 12 ft. wide, runs round the interior of the building, having an area of 1,500 yards; access to it is obtained by six staircases; this gallery will be occupied by dealers in light wares, such as baskets, shoes, &c. Under the gallery are sixty shops, averaging in size about 12 ft. square; a few more near the entrance are larger: each shop is fitted with an oven and grate. The centre of the hall is occupied by eighty large and seventy small stalls, and four rows of tables, each row 210 ft. long. Altogether there is accommodation for 600 salesmen. The principal avenue is 24 ft. broad, crossed at right angles by one 19 ft. wide; the passage round the stalls is about 12 ft. 6 in. wide. The whole of the iron work is painted light blue, with red stringing. The whole of the roof covering the market is of rough plate glass; the spans of the principals are 50 ft. and 25 ft., the apex of the main roof being nearly 54 ft. from the ground floor, and the glass consumed for this purpose weighs 80 tons, and measures 30,000 ft. Complete ventilation is effected by the louvre lights in the roof. A plentiful supply of water is obtained from the Corporation mains. Six hydrants have been fitted up in different parts of the building, and are so constructed that a hose may be readily attached to them.

The following particulars may be interesting: there are 35,409 cubic yds. of excavation; 12,028 cubic yds. of rubble walling; 13,645 superficial yds. of brickwork; 6,644 superficial yds. of flagging; 59,924 cubic ft. of ashlar.

The following Table shows the size of the Bolton Market Hall, in comparison with some of the principal ones in South Lancashire:

	Length.		Breadth.		Area.		
	yds.	in.	yds.	in.	yds.	ft.	in.
St. John's, Liverpool	595	0	135	0	8,923	8	0
Bolton Market	294	5	219	9	7,188	6	9
To this add gallery-space, 1,500 yds., making total =					8,688	6	9
Birkenhead Market	454	0	154	0	7,768	0	0
St. James, Liverpool	174	6	150	5	2,916	3	2

We think the Bolton Market Hall one of the best we know, still we feel bound to mention one drawback to its completeness, which we believe will be found rather serious in summer. The stalls and tables, as finished at present, are covered by the rough glass roof alone, and in the hot weather all goods placed in them, as well as sellers and buyers, will be exposed to the full glare of the sun, unless the proprietor of each stall or table is permitted to put up, as he pleases, awnings, umbrellas, or any other unsightly shelter. To prevent this, we suggest the propriety of putting up a light corrugated iron screen over the stalls, in the same way as the screen is fitted over the stalls in the Birkenhead Market, and we are sure that this kind of screen would not spoil the architectural beauty of the building, but would rather do away with its only defect, that of too much glare, and would greatly add to the comfort of its occupiers.

We think the Bolton Market Hall reflects great credit on the taste and judgment of the architect, Mr. G. T. Robinson, of Leamington, and that great praise is due to Mr. William Tomkinson, of Liverpool, the contractor, who has so ably carried out the design, and to Mr. Matthew Jepson, the efficient clerk of the works. The building cost about £50,000; with the land, approaches, &c., the total cost amounts to £90,000. The gross income is expected to be about £4,000 per annum.

NOTES BY A PRACTICAL CHEMIST.

Alloy for Composition Files.—These are employed for applying polishing rouge to small metallic objects, especially by watchmakers in polishing steel pins, and in producing an intense black polish in some parts of watches. They consist of copper, 8 parts, tin, 2 parts, zinc and lead, 1 part each, melted together under a coat of borax. A very slight deviation from the proportions here indicated materially affects.

Process for absorbing Corrosive Vapours which escape from the Chimneys of Chemical Works.—The vapours are made to traverse a body of lime maintained at a high temperature by a lateral fire.

Solubility of Sulphate of Baryta in Acid Liquors.—The insolubility of sulphate of baryta has always been depended upon in testing. Professor Calvert, however, finds that it is materially affected both by nitric and hydrochloric acids, the former of which is capable of dissolving 1-500th of its weight of sulphate of baryta.

Preparation of Sulphate of Soda from Common Salt and Gypsum or Sulphate of Magnesia.—Equivalent proportions of sulphate of lead, prepared by roasting galena and common salt (chloride of potassium may be used if sulphate of potash is required), are mixed and exposed to a strong red heat. On fusion, sulphate of soda and chloride of lead are produced. The latter sublimes, and is condensed in a proper apparatus. The residue is treated with water, and allowed to crystallise. A portion of undecomposed sulphate of lead remains undissolved. The chloride of lead obtained is ground up and mixed with a solution of gypsum, kept suspended by agitation. Sulphate of lead is thus reproduced, whilst a solution of chloride of calcium remains. The former, after being well washed, is mixed with the portion of sulphate left undissolved, and employed in converting a second portion of common salt. Thus, oxide of lead serves as a means of constantly transferring sulphuric acid from gypsum to soda. Care must be taken that the solution of chloride of calcium in contact with the sulphate of lead be kept very dilute, otherwise a part will be dissolved.

The chloride of sodium and common salt may be calcined, either in retorts or on a hearth, but it should be spread out in shallow layers, and a current of air should play over the mass, carrying the sublimed chloride of lead into a proper condensation chamber in connexion with the chimney.

Preparation of Soda, Caustic, or Carbonate, from Common Salt.—Common salt is mixed with pyrophosphate of lead, and calcined, as above, yielding pyrophosphate of soda and a sublimate of chloride of lead. The former is taken up in water, leaving undecomposed pyrophosphate of lead undissolved. This solution is treated with lime, which takes the pyrophosphoric acid, and sets free the soda, which is drawn off. The pyrophosphate of lime is suspended in water and treated with the chloride of lead, which is thus reconverted into hydrophosphate. This is separated from the solution of chloride of calcium, and employed for the decomposition of further portions of salt.

Otherwise, phosphate of lime may be decomposed by sulphuric acid, and the phosphoric acid obtained employed in the same way as sulphuric acid in the decomposition of common salt, thus yielding hydrochloric acid and pyrophosphate of soda. The latter is dissolved and treated with lime, which sets free the soda, and forms pyrophosphate of lime, from which phosphoric acid is again liberated by sulphuric acid, and employed in the treatment of a new portion of salt.

Otherwise, phosphate of lead is decomposed by muriatic acid yielding chloride of lead and phosphoric acid. The latter serves to decompose common salt, producing muriatic acid and pyrophosphate of soda, which, when dissolved in water and treated with lime, yields soda and pyrophosphate of lime. The latter is boiled with water and the chloride of lead previously formed, thus reproducing chloride of calcium and phosphate of lead.

Preparation of Sulphuric Acid from Gypsum and other Sulphates.—Phosphate of lead is decomposed by hydrochloric acid. The phosphoric acid thus obtained is mixed with sulphate of lime and calcined, when phosphate of lime remains and sulphuric acid passes over. The phosphate of lime is decomposed by boiling with water and the chloride of lead obtained above, yielding phosphate of lead. This is decomposed by hydrochloric acid, and the phosphoric acid thus obtained used with a fresh portion of lime. In this process, hydrochloric acid is the only substance consumed, being thrown off as chloride of calcium;

but if the sulphuric acid thus obtained be used in converting common salt into soda, an equivalent amount of hydrochloric acid will be obtained. Or muriatic acid may be obtained by heating chloride of magnesium with clay.

N.B.—A view of the economical results of these processes, as compared with the common methods, would be very desirable.

Native Iron of Terrestrial Origin.—It has been generally supposed that native iron exists only in meteoric stones. In Siberia, on the West Coast of Africa, large deposits of malleable native iron exist in a state of great purity. It contains not a trace of carbon. From meteoric iron it is distinguished by the absence of nickel.

Preparation of Aluminium.—The most advantageous material is *cryolite*, a double fluoride of aluminium and sodium, which is obtained on a commercial scale in Greenland. The process is as follows :—Finely ground cryolite is stratified with sodium in an iron crucible, 46 millimetres high, and 4 centimetres wide at top. The mass is pressed down, covered with chloride of potassium, and closed with a good porcelain lid. The proportions are—5 parts cryolite, 5 chloride of potassium, and 2 sodium. The whole is heated for half an hour in a gas flame with a good draught, and when cool the aluminium is detached by a chisel. The mass is then digested for twelve hours in a silver vessel, crushed in a mortar, treated with dilute nitric acid, dried, and sifted. The globules of aluminium are then united by fusion in a porcelain crucible, under a layer of double chloride of aluminium and sodium. The yield varies from 0·8 gram. (when 10 gram. of cryolite have been employed) to 0·3. Theory requires 1·3, so that there is still much room for improvement.

ANSWERS TO CORRESPONDENTS.

"N. S."—Iceland spar is a crystalline carbonate of lime.

"Metallicus."—The rumoured *identity* of silicium and silver requires confirmation, though a considerable similarity may exist.

AMERICAN NOTES, 1856.—No. III.

UNITED STATES NAVAL STEAM FRIGATES.

The Niagara.—The following are the principal dimensions and capacities of this peculiar steamer :—

Hull built at United States Navy Yard, Brooklyn ; Engines by Pease and Murphy, proprietors of Fulton Foundry, New York.

Extreme length from taffrail to eagle's beak	345 ft.
Length on load line	328 ft. 10½ in.
Breadth of beam, molded	53 ft. 8 in.
Breadth of beam, extreme	55 ft.
Depth of hold to spar deck	31 ft. 3 in.
Length of engine space	100 ft.
Tons	4,750.

Ratio of length to breadth on load line, 5·979 ; height of port sill above load line, 14 ft. 10 in. ; distance of dead flat abaft middle of length on load line, 7 ft. 3 in. ; centre of buoyancy abaft middle of length on load line, 8 ft. 7¾ in. ; centre of gravity of displacement below load line, 8 ft. ; molded displacement at 23 ft. draught, 5,110 tons ; total displacement at 23 ft. draught, 5,440 tons ; area of load water line, 12,755 sq. ft. ; meta centre above load-line, 5 ft. 6 in. ; movements of stability (S $\frac{2}{3} y^s ax$), 2,415,560 sq. ft. ; weight of hull, 2,750 tons ; weight of iron bolts in hull, 400,000 lbs. ; weight of galvanised iron and girder, 130,000 lbs. ; weight of copper bolts, 25,000 lbs. ; weight of composition bolts, 15,000 lbs. ; weight of diagonal iron braces, 169,000 lbs. ; armament, 12 11-in. pivot guns, probable weight of each, 2,700 lbs. ; kind of engines, horizontal cross head, with double pistons ; ditto boilers, vertical, return tubular ; diameter of cylinders (three), 72 in. ; length of stroke, 3 ft. ; diameter of screw, 18 ft. 3 in. ; length of screw, 4 ft. 8 in. ; pitch of screw, 29 ft. 6 in. ; number of blades of screw, 2 ; number of boilers, 4 ; length of ditto, 11 ft. 6 in. ; breadth of ditto, 21 ft. ; height of ditto, exclusive of steam chests, 15 ft. ; number of furnaces, 6 in each boiler ; breadth of ditto, 2 ft. 10½ in. ; length of fire bars, 7 ft. 4 in. ; number of tubes in each boiler, 2,040 ; internal diameter of ditto, 1¾ in. ; length of ditto, 3 ft. 3 in. ; diameter of chimneys (two), 7 ft. ; height of ditto, 60 ft. ; area of immersed section at load draft, 911 ft. ; load on safety-valve in lbs. per sq. in., 20 ft. ; heating surface, 17,500 ft. ; contents of bunkers in tons, 1000 ; draft of water at load line, 23 ft. ; maximum revolutions, 40 ; point of cutting off, ⅝ lbs. ; weight of engines, extra pieces, boats, and boilers, without water, 600 tons ; weight of boilers, 285 tons ; frames of line out, 20½ in. × 15 in., and 40 in. apart, filled in solid to a line 6 ft. above the bare line ; hull, strapped with diagonal and double laid straps ; masts, 3 ; rig, ship ; weights : hull, 2,750 tons ; spars, rigging, and sails, 221 tons ; armament, 257 tons ; stores, 326 tons. Total, 3,558 tons.

The *Wabash*, at Philadelphia, the *Merrimack*, at Boston, the *Minnesota*, at Washington, the *Colorado* and *Roanoke*, at Gosport, are of similar models, with the exception of slight differences in length, but have the same displacement. The *Merrimack* is 5 ft. 8 in. less in length than the *Wabash*.

DIMENSIONS OF THE "WABASH."

Length between perpendiculars	265 ft. 8 in.
Length from knight head to taffrail	287 ft. 7 in.
Length over all	301 ft. 6½ in.
Beam, molded	50 ft. 2 in.
Beam, extreme	51 ft. 4 in.
Depth of hold to gun deck	26 ft. 2 in.
Depth of hold to spar deck	32 ft. 7 in.
Tons	3,200.

Kind of engines, two of direct action ; ditto, boilers, vertical tubular ; diameter of cylinders, 72 in. by 3 ft. stroke of piston ; heating surface to boilers, 11,500 sq. ft. ; grate surface, 320 sq. ft. ; diameter of propeller, 17 ft. 4 in. ; number of blades, 2 ; pitch, 23 ft.

The U.S. "Nautical Magazine," in referring to these vessels, furnishes the following elements, intermixed with some strictures upon the construction department of the Navy, which I have omitted as being of too local a bearing for your readers at large :—

"In the appropriation for these six auxiliary steamers, there was one prominent exception. Congress determined that one of these ships should be constructed by a private builder, and Mr. George Steers, the constructor of the yacht *America*, was entrusted with her construction ; while the other five were left in the hands of the Bureau of Construction, perhaps that their models might indicate their origin. In conformity with the usages of the department, names were given to the several vessels after the rivers of our country, and the one to be built by Mr. Steers, at the Brooklyn Navy Yard, was called the *Niagara*. This vessel was commenced in 1854, and is now about ready, and will be launched as soon as the water in the launching slip shall have been sufficiently deepened. It was but reasonable to suppose that every facility would be afforded Mr. Steers, now that improvement seemed to be really intended, and, with the exception of the propelling power in the quality of the canvas, the ground tackle in the kind of anchors, and the ventilation in the improved side-lights he has thought proper to use, he has been allowed to exercise his own judgment, both in the model and manner of construction, and is, like the constructor of the *Ohio*, quite willing to take the whole measure of responsibility, having a full knowledge of its weight and bulk. This vessel, as her dimensions and calculations will show, is the largest of the six, and is also of a very different model and construction.

"In the construction of the *Niagara* it is alleged that there are principles involved which are of great importance to the safety of vessels, which have never been appreciated in the navy, either in this country or elsewhere. It was supposed that in the model and internal arrangements alone would this vessel differ from the other five vessels ; but it is discoverable that not only is the form of the fabric and her arrangements in armament different, but that the manner of distributing the materials throughout the vessel is also entirely different, utility being regarded as of more consequence than the time-honoured precedents, the constructor having sought to secure the greatest amount of strength with the least bulk. The *Niagara* has, like the other five ships, a live oak frame, with this difference—she is filled in with yellow pine, her bottom is also of yellow pine, her frame is strapped with iron on the *outside* instead of the *inside* as the others."

STEAM NAVIGATION.

Vanderbilt's European Line.—The following are the principal dimensions of hull and engines of this steamer :—

DIMENSIONS OF STEAMER "VANDERBILT."

Built by J. Simonson ; Engines by Allaire Works, New York.

Length on deck	331 ft.
Breadth of beam, molded	37 ft. 6 in.
Depth of hold	24 ft. 6 in.
Depth of hold to spar deck	32 ft. 6 in.
Length of engine space	114 ft.
Hull, carpenter's	5,000 tons.

Kind of engines, vertical beam ; ditto boilers, horizontal, return tubular ; diameter of cylinders, 90 in. ; length of stroke, 12 ft. ; diameter of paddle-wheel over boards, 41 ft. ; length of boards, 10 ft. ; depth of ditto, 2 ft. ; number of ditto, 36 ; number of boilers, 4 ; length of ditto, 28 ft. 6 in. ; breadth of ditto, 13 ft. 11 in. ; height of ditto, exclusive of steam chests, 13 ft. 6 in. ; number of furnaces, 8 in each boiler ; length of fire-bars, average, 6 ft. 6 in. ; internal diameter of tubes, 3 in. ; diameter of chimneys, 8 ft. 8 in. ; height of ditto, 40 ft. ; area of immersed section at load draft, 825 ft. ; contents of bunkers in tons, 1,200 ; frames, 21 in. molded, 15 in. sided, and 32 in. apart ; depth of keel, 11 in. ; independent steam, fire and bilge pumps, 2 ; masts, 2 ; rig, topsail schooner ; intended service, New York to Liverpool. Hull strapped with 320 diagonal and double-lined braces, 5 × ⅝ in. Floors bolted fore and aft.

Boston and Portland Line.—The following are the principal dimensions and particulars of a new steamer now completing for this line :—

DIMENSIONS OF STEAMER "LEWISTON."

Built by John Englis ; Engines by Neptune Iron Works, New York.

Length on deck	246 ft.
Breadth of beam	33 ft.
Depth of hold to spar deck	12 ft. 3 in.
Register	1,000 tons.

Kind of engine, vertical beam ; ditto boiler, return flued ; diameter of cylinder, 52 in. ; length of stroke, 11 ft. ; diameter of paddle-wheel over boards, 31 ft. ; length of boards, 7 ft. 8 in. ; depth of ditto, 2 ft. 4 in. ; number of ditto, 27 ; number of boilers, 1 ; length of ditto, 29 ft. ; breadth of ditto, furnace, 13 ft. 6 in. ; shell, 11 ft. ; height of ditto, exclusive of steam-chests, 11 ft. 5 in. ; number of furnaces, 3 ; breadth of ditto, 3 ft. 4½ in. ; length of fire-bars, 7 ft. 6 in. ; number of flues, 10 ; number of upper flues, 6 ; diameter of ditto, 1 ft. 5 in. ; diameter of chimney, 5 ft. ; height of ditto, 32 ft. ;

area of immersed section at load draft, 228 ft.; heating surface, 1,837 ft.; draft forward and aft, 8 ft. Frames, molded, 15 in., sided, 14 in., and 24 in. apart; depth of keel, 8½ in.; independent steam, fire, and bilge pumps, 1; masts, 2; rig, schooner; intended service, Boston to Portland; sponsons under guards, fore and aft. Hull strapped with iron, 4 × ¾ in. Cabins on spar deck, and a promenade deck.

Glasgow and New York Steam Ship Company.—The Edinburgh.—This line has resumed its trade with this port, and if the new steamer just reached here is an earnest of the intentions of its directors, they mean to pursue a vigorous and effective trade. This last essay that has reached here will not detract from the high reputation that her builders, Messrs. Tod and McGregor, of Glasgow, so justly enjoy. The following are her principal dimensions and characteristics:—

DIMENSIONS OF STEAMER "EDINBURGH."

Built by Tod and McGregor, Glasgow.

Kind of engines, steeple; ditto boilers, horizontal, return tubular; diameter of cylinders, 76 in.; length of stroke, 6 ft.; diameter of screw, 14 ft.; pitch of screw, 20 ft.; number of blades of screw, 3; number of boilers, 4; number of furnaces, 3 in each; load on safety-valve in lbs. per sq. in., 12; cut off at ⅝ in.; contents of bunkers in tons, 650; consumption of coals per hour, 45 tons; draft, loaded, 17 ft. 9 in.; revolutions, 17; geared, 3 to 1; frames, shape ˥_, 6 in. × ½ in. × 3 in. and 18 in., apart; strakes of plates from keel to gunwale, ⅞ to ⅝ in. thickness; number of bulkheads, 3; diameter of rivets, ¾ in.; distances apart, 3½ in. and double rivetted; depth of keel, 13 in.; dimensions of ditto, 13 in. × 2½ in.; independent steam, fire, and bilge pumps, nine; masts, 3; rig, ship; intended service, Glasgow to New York.

MISCELLANEOUS.

Improved Street-Sweeping Machine.—A new machine, styled the "American Street-Sweeping Machine," invented and patented by Robert A. Smith, is simple in its construction and effective in its action.

It consists of two cylinders of brooms running diagonally across and under a cart-body. A portion of one of these cylinders extends forward and outside of the right or gutter-wheel. The brooms, by a simple contrivance, are made easily adjustable, so as to conform, as the vehicle progresses, to the ordinary inequalities of gutters or street services. The brooms receive their motion from gearing connected with the left wheel; so that, as the vehicle advances, the cylinders revolve with a motion reversed to that of the cart.

The dirt is thrown into *windrows*, from whence it can be gathered into carts or tenders, and carried away. The entire machinery is extremely simple and substantial in its construction, is not liable to get out of order, and can be operated by any labourer of ordinary capacity.

The cost of working these machines is about 2½ dols. (10s. sterling) each per day. Where streets have not been long neglected and the dumping ground was convenient, so that little time was lost in unloading the carts, two of these machines, attended by six carts and six men, have cleansed in 10 hours a street surface equal to 120,000 square yards, as was frequently demonstrated by the patentee himself during his experimental operations in New York.

Improvement in the Construction of Hulls of Vessels.—J. B. Stoddard, Sen., of Baltimore, has designed the construction of the hull of a vessel with iron frames, and the planking and ceiling fitted over them in such a manner that the out-board surface of the ceiling and the in-board surface of the planking join each other. They are then bolted together through the flanges of the frame, and caulked both inside and outside.

The following are some of the advantages which the inventor claims, but not expressed as unqualifiedly as he has seen fit to:—

1st. A vessel built on this plan will be free from *bilge water*, which not only damages many vessels' cargoes, but gives rise to that *miasm* which generates ship fever. It is a singular fact that sea water is much more apt to enter into putrefactive decomposition than fresh water. This depends upon the great quantity of organic matter which it contains. This organic matter, when combined with the filth which necessarily accumulates between the timbers of vessels, as now built, readily enters into the putrefactive decomposition, and gives rise to those noxious gases, the inhalation of which predispose the system to malignant or ship fever.

2nd. A vessel built on this plan is less liable to leak, for every plank forms a stop water for every seam, and if one or more planks are started from her side, she may yet be tight, as her ceiling is caulked.

3rd. A vessel built on this plan can be *bulkheaded*, so as to convert her hold into separate chambers, and, by so doing, form a perfect life-boat of the ship, and, with the forecastle bulkhead built watertight, if she should run into a field of ice or another vessel and break in her bows, she would still be able to continue on to the nearest port, and discharge her cargo dry, for the forecastle bulkhead would form a reserve bow, and act as a perfect stop-water.

4th. A vessel built on this plan will last much longer, and need less repairs, than one built as they are now built.

5th. A vessel built on this plan with iron frame, which is the best, cheapest, and strongest manner of building, cannot be chafed through with ice, for when it has cut through the outside plank, it meets the iron frames which it cannot cut, and which protect the ceiling, which, being caulked, is perfectly tight.

Improved Method of Working Engine Feed Pumps.—Mr. John R. Seer, of this city, has designed an arrangement for the working of feed pumps, whereby the constant and consequent more reliable operation of this instrument of safety is effected.

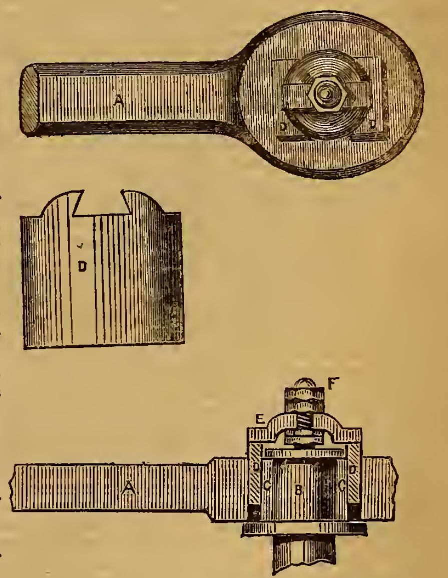
It consists in the simple introduction of an intermediate shaft between the driver or operator of the pump and the pump, upon which projects an arm, over which slides an adjustable centre, to which are attached the connexions to the operator and the pump. The position of this centre upon the arm, of course, determines the radius of its vibration and consequent stroke of the pump. In support of the utility of this arrangement, the inventor declares:—

"It is well known to engineers to be a great desideratum to be enabled to supply a steam boiler with water as fast as it is evaporated, and to have this supply constant and continuous. At present there is no effective mode of doing this, for the stroke of the pump remaining the same, whether the boiler is evaporating a greater or less amount of water, the supply has to be intermittent, resulting in the boiler containing some times a greater amount, and at others a less amount of water than is absolutely necessary. It is also equally well known that the force pump will not work effectually without working at each stroke a *full* supply of water, and that when the supply is attempted to be regulated by a cock in the supply pipe, and the barrel of the pump only partially filled, that the operation of it is rendered very uncertain and therefore unsafe. More particularly is this the case with the pumps of locomotive engines, when running at the high rates of speed now demanded by the travelling community."

Improvements in securing Brasses in Connecting Rods.—The improvement in securing journal brasses in connecting rods, and following up their wear, represented in the engraving below, is the invention of Mr. John R. Sees, of this city, who has taken the necessary steps to secure a patent for it.

It is alleged that it possesses several advantages over the method of securing brasses by a strap, gibs, and key, as ordinarily used, of which the following he regards as the most important. 1st. A saving of expense in "fitting up" the rod, it costing not more than one-third as much as the old plan, according to the estimate of some machinists; 2nd. In preserving the distance from centre to centre of the brasses at either end of the rod, in adjusting them to make up for the wear, however great it may be, which is a most important consideration, particularly as regards locomotive engines, or engines with parallel motions; and 3rd. In the facility with which the brasses are adjusted. There have been many previous attempts made to effect the objects designed by this improvement, but they have fallen short of the expectations of their inventors when they have been put to a practical test, and the strap, gibs, and key are almost universally used.

A represents the head or box-end of a connecting rod, bored out to fit and receive the brasses, C C; B the pin to which the rod is attached; C C are the brasses, turned on the outside to fit the rod, and bored out on the inside to fit the pin. They are or can be made in one piece and cut asunder. D D are two plano-cylindrical wedges, fitted on the front to the brasses, C C, and made slightly tapering on the back, and fitted into cavities in opposite sides of the hole made in the head to receive the brasses. E is a bridge-piece, connected by dovetails at the ends to the wedges, D D, and in the centre to the pin, B, by the set screw, F, revolving freely around it, and adjusted in position by jamb or check-nuts. The brasses are prevented from turning in the head, by feathers inserted in them as shown in the engraving. The collar on the back side of the pin, B, is made of sufficient width to cover the ends of the box, and lap over on to the head of the rod, so that the rod is retained in position sidewise, by the collar on one side, and the wedges on the other.



To tighten the brasses to follow up their wear, the jamb-nuts below the bridge are loosened—the jamb-nuts above the bridge are turned down until the brasses are properly tightened up, when the lower jamb-nuts are again adjusted in position. The brasses are both moved equally by the operation of the wedges, so that the centres are preserved constant, however much may be the wear.

This is an improvement. The inventor is an engineer, and has been engaged in some of our European steamers for the last five years.

Glue Impervious to Water.—If a coating of glue or size be brushed over with a decoction of one part of powdered gall nuts in twelve of water, reduced to eight parts and strained, it becomes hard and as solid and impervious to water as a coat of oil paint; in fact, a kind of leather is formed.

THE VICTORIA BRIDGE AT MONTREAL.

REPORTS OF MR. ROBERT STEPHENSON AND MR. A. M. ROSS.

To the Chairman and Directors of the Grand Trunk Railway Company of Canada.

Gentlemen,—Having learnt that some doubts have been expressed respecting the fitness of the design for the Victoria bridge across the St. Lawrence at Montreal,—that it is more costly than necessary, and that other systems of structure less expensive, yet equally efficient, might with propriety be adopted, —I feel called upon to lay before you in some detail the considerations which influenced me in recommending the adoption of the design which is now being carried out. In doing so, I beg to assure you that the subject was approached in the outset, both by Mr. Alexander Ross, your engineer in Canada, and myself, with a thorough consciousness of the enormous expense which must inevitably be involved, whatever description of structure might be adopted; also of the large proportion which this cost must bear to the entire outlay of the undertaking of the Grand Trunk Railway of Canada. We were, therefore, fully alive to the imperative necessity of studying the utmost economy in every part of the work, consistent with our notions of efficiency and permanency.

It will be my endeavour, in the following remarks, to satisfy you and those interested in the undertaking, that these objects have been steadfastly kept in view.

It would evidently be unreasonable to expect that, amongst professional men, an absolute identity of opinion should exist, either in reference to the general design, or in many of the details, of a work intended to meet such unusually formidable natural difficulties as are to be contended with in the construction of a bridge across the St. Lawrence.

You will remember, that at the time I first entered upon the consideration of the subject, these difficulties were deemed by many well acquainted with the locality, and publicly stated by them to be, if not insurmountable, at all events of so serious a character as to render the undertaking a very precarious one.

The information I received respecting these obstacles, when my attention was first drawn to this project, was so striking, that I reserved forming an opinion until I had visited the spot; had well considered all the detailed information which Mr. Alexander Ross had collected during several months' previous residence in the country; and had heard the opinion of many intelligent residents regarding the forces exhibited by the movements of the huge masses of ice during the opening of the river in spring.

The facts gathered from these sources fully convinced me that, although the undertaking was practicable, the forces brought into action by the floating ice, as described, were of a formidable nature, and could only be effectively counteracted by a structure of a most solid and massive kind.

All the information which has been collected since I made my first report has only tended to confirm the impressions by which I was then guided.

For the sake of clearness and simplicity, the consideration of a design may be divided into four parts:—1st. The approaches; 2nd. The foundations; 3rd. The upper masonry; and, 4th. The superstructure, or roadway.

The approaches, extending in length to 700 ft. on the south, or St. Lambert side, and 1,300 ft. on the Point St. Charles side, consist of solid embankments formed of large masses of stone, heaped up and faced on the sloping sides with rubble masonry. The up-stream side of these embankments is formed into a hollow shelving slope, the upper portion of which is a circular curve of 60 ft. radius, and the lower portion, or foot of the slope, has a straight incline of three to one, while the down-stream side, which is not exposed to the direct action of the floating ice, has a slope of one to one. These embankments are being constructed in a very solid and durable manner, and from their extending along that portion of the river only where the depth at summer level is not more than 2 ft. 6 in., the navigation is not interrupted, and a great protection is, by their means, afforded to the city, from the effect of the "shoves" of ice, which are known to be so detrimental to its frontage.

For further details on this subject I beg to refer you to the report made by Mr. Ross and myself on the 6th of June, 1853, to the Honourable the Board of Railway Commissioners, Quebec.

Advantage has also been taken of the shallow depth of water in constructing the abutments, which are each 242 ft. in length, and consist of masonry of the same description as that on the piers, which I am about to describe; and, from their being erected in such a small depth of water, their foundations do not require any extraordinary means for their construction.

The foundations, as you are aware, are fortunately on solid rock, in no place at a great depth below the summer level of the water in the river.

Various methods of constructing the foundations suggested themselves, and were carefully considered; but, without deciding upon any particular method of proceeding, it was assumed that the diving-bell, or such modifications of it on a large scale as have been recently employed with great success in situations not very dissimilar, would be the most expedient. The contractors, however, or rather the superintendent, Mr. Hodges, in conjunction with Mr. Ross, after much consideration on the spot, devised another system of laying the foundations, which was by means of floating "coffer-dams," so contrived that the usual difficulty in applying coffer-dams for rock foundations would be, it was hoped, in a great measure obviated. When in Montreal, I examined a model of this contrivance, and quite approved of its application, without feeling certain that it would materially reduce the expense of construction below that of the system assumed to be adopted by Mr. Ross and myself in making the estimate. In approving of the method proposed by Mr. Hodges, I was actuated by the feeling that the engineers would not be justified in controlling the contractors in the adoption of such means as they might consider most economical to themselves, so long as the soundness and stability of the work were in no way affected.

This new method has been hitherto acted upon with such modifications as experience has suggested from time to time during the progress of the work; and, although successfully, I learn from the contractors that experience has proved the bed of the river to be far more irregular than was at first supposed,—presenting, instead of tolerably uniform ledges of rock, large loose fragments, which are strewed about, and cause much inconvenience and delay.

They are therefore necessitated to vary their mode of proceeding to meet these new circumstances; and it may be stated, that all observations up to this time show the propriety, notwithstanding the difficulty with dams, of carrying the ashlar masonry of the piers down to the solid rock, and that any attempt at obtaining a permanent foundation by means of concrete confined in "caissons" would be utterly futile; however, if it were assumed to be practicable, there would be extreme danger in trusting such a superstructure of masonry upon concrete, confined in cast-iron "caissons" above the bed of the river; indeed, considering the peculiarities of the situation and the facts which have been ascertained, this mode of forming foundations is the most inappropriate that can be suggested, as it involves so many contingencies that to calculate the extreme expense would be utterly impossible.

These considerations lead me therefore to the conclusion that the present design for the foundation is as economical as is compatible with complete security.

We are now brought to the question as to whether the upper masonry is of a more expensive description than necessary, or whether it can be reduced in quality. This question is exceedingly important, since the cost of the masonry constitutes upwards of 50 per cent. of the total estimated cost of the bridge and approaches. The amount of the item of expenditure for the masonry is clearly dependent upon the number of piers, which is again regulated by the spans between them.

The width of the openings in bridges is frequently influenced, and sometimes absolutely governed, by peculiarities of site. In the present case, however, the spans, with the exception of the middle one, are decided by a comparison with the cost of the piers; for it is evident that so soon as the increased expense in the roadway, by enlarging the spans, balances the economy produced by lessening the number of piers, any further increase of span would be wasteful.

Calculations, based upon this principle of reasoning, coupled to some extent with considerations based upon the advantages to be derived from having all the tubes as nearly alike as possible, have proved that the spans which have been adopted in the present design for all the side openings, viz., 242 ft., have produced the greatest economy. The centre span has been made 330 ft., not only for the purpose of giving every possible facility for the navigation, but because that span is very nearly the width of the centre and principal deep channel of the stream.

The correctness of the result of these calculations obviously depends upon the assumption that the roadway is not more costly than absolutely necessary; for if the comparison be made with a roadway, estimated to cost less than the tubular one in the design, then the most economical span for the side openings would have come larger than 242 ft., and the amount of masonry might have been reduced below what is now intended. In considering the quantity of masonry in the design, you must, therefore, take it for granted for the moment, that the *tubular roadway* is the cheapest and best that could be adopted, and leave the proof of this fact to the sequel of these remarks.

It may perhaps appear to some, in examining the design, that a saving might be effected in the masonry by abandoning the inclined planes which are added to the up-side of each pier, for the purpose of arresting the ice, and termed "ice-breakers."

In European rivers, and I believe in those of America also, these "ice-breakers" are usually placed a little way in advance of, or rather above, the piers of the bridges, with a view of saving them from injury by the ice shelving up above the level of (frequently on to) the roadway.

In the case of the Victoria bridge, the level of the roadway is far above that to which the ice ever reaches; and as the ordinary plan of "ice-breakers," composed of timber and stone, would be much larger in bulk, though of a rougher character than those which are now added to the piers, I have reason to believe that they would be equally costly, besides requiring constant annual reparation; it was therefore decided to make them a part of the structure itself, as is now being done.

To convey some idea of the magnitude of ordinary "ice-breakers" placed on the up-side of the pier, and to enable you to form some notion of their cost, I cannot do better than quote the following, from the excellent report addressed to the Honourable John Young, by Mr. Thomas C. Keefer, whose experience in such matters, from long residence in the country, entitles his opinion, as to the proper character of such works, to confidence:—

"The plan I have proposed contemplates the planting of very large "cribs," or wooden "shoes," covering an area of about 1-4th of an acre each, and leaving a clear passage between them of about 240 ft.,—a width which will allow ordinary rafts to float broadside between them. These "islands" of timber and stone will have a rectangular *well* left open in the middle of their width, toward their lower ends, out of which will rise the solid masonry towers supporting the weight of the superstructure, and resting on the rocky bed of the river. This enclosure of solid crib-work all round the masonry, yet detached from it, will receive the shock, pressure, and grinding of the ice, and yield to a certain extent by its elasticity, without communicating the shock to the masonry piers. These cribs, if damaged, can be repaired with facility, and, from their cohesive powers, will resist the action of the ice better than ordinary masonry. During construction, they will serve as coffer-dams, and, being formed of the cheapest materials, their value as service-grounds or platforms for the use of machinery, the moving of scows, &c., during the erection of the works, will be at once appreciated. Their application to the sides of the piers is with particular reference to preventing the ice from reaching the spring of the arches, which will be the lowest and most exposed part of the superstructure, if wood be used."

In the first design for the Victoria bridge, "ice breakers" very similar to the above described by Mr. Keefer were introduced, but subsequently the arrangement was changed, partly with a view of gaining the assistance of the whole weight of the bridge to resist the pressure of the ice before it became fixed, and partly for the purpose of obviating a considerable annual outlay.

I have not data at hand to estimate correctly the cost of the ordinary "ice-breakers" as described, but I have little or no doubt that, as I have before stated, they would have required to have been large and substantial masses of stone and timber, which in amount of cost would be scarcely less than, if not equal to, the inclined planes of masonry which have been added to the up side of the piers. On this point, however, as well as upon others in reference to some reduction in the quantity of masonry in the piers and abutments, I intend to address Mr. Ross, who being on the spot will be able to determine with more accuracy than I can the amount of actual saving which can be effected in the masonry.

It is now necessary for me to say a word or two upon the style of the workmanship. It consists simply of solid ashlar, and considering the severe pressure and abrasion to which it will be subjected by the grinding of the ice, and the excessively low temperature to which it will for months be periodically exposed, I am confident that it is not executed with more solidity than prudence absolutely demands; and, considering the difference of the rates of wages in Canada and this country, I believe the price of the work will come out nearly the same as any similar work let (here) by competition.

The description and style of the masonry is precisely similar to that adopted in the Britannia bridge, the material is the same, and the facility of obtaining it is not in any important degree dissimilar.

The next point to be discussed is the construction of the superstructure or roadway; and here, owing to the misconception which seems to exist on this subject amongst some engineers, I am compelled to enter somewhat into technical details, in reference to the treatment and construction of beams.

The matter has already been debated before the Institution of Civil Engineers at great length, arising out of a paper read by Mr. Barton, on the construction of the bridge over the river Boyne, erected under the direction of Sir John Macneill.

In the design of this bridge, the engineer has adopted what is technically termed the "trellis" system of beam or girder, for the avowed purpose of saving material, as compared with the plain tubular system adopted in the Britannia, and now proposed for the Victoria bridge.

It has been already stated that the design and cost of masonry materially depend upon the comparative expense which may be incurred in the construction of the roadway, since the spans or openings adopted are really governed by this item in the estimate. It is, therefore, doubly necessary that this part of the proposed design should be analysed with great care.

Notwithstanding the discussion which took place at the Institution of Civil Engineers, as to the comparative merits of constructing beams in almost every variety of detail, it certainly appears, as far as I am able to form a judgment, that much error still prevails regarding the simple principles that should, and indeed must, govern the arrangement of every beam bridge.

The tubular system is openly declared by some to be a wasteful expenditure of material for the attainment of a given strength—in short, that in the scale of comparative merit, it stands at the lowest point. This, if it were the fact, would not be extraordinary, since it was the first proposed for carrying railways over spans never before deemed practicable; but in the following remarks I hope to convince you, in the simplest manner, that, except in particular cases, whilst it is not a more costly method of construction, it is the most efficacious one that has hitherto been devised.

At present there may be regarded as existing three methods of constructing wrought-iron girders or beams for railway purposes:—

1st. The "Tubular Girder," or what is sometimes called the Box-girder, when employed for small spans, with which may also be named the single-ribbed girder—the whole belonging to the class known as "Boiler-plate" girders.

2nd. The "Trellis Girder," which is simply a substitution of iron bars for the wood in the trellis-bridges, which have been so successfully employed in the United States, where wood is cheap and iron is dear.

3rd. The "Single-triangle Girder," recently called "Warren," from a patent having been obtained for it by a gentleman of that name.

Now in calculating the strength of these different classes of girders, one ruling principle appertains and is common to all of them. Primarily and essentially the ultimate strength is considered to exist in the top and bottom,—the former being exposed to a compressive force by the action of the load, and the latter to a force of tension; therefore, whatever be the class or denomination of girders, they must all be alike in amount of effective material in these members if their spans and depths are the same, and they have to sustain the same amount of load.

On this point I believe there is no difference of opinion amongst those who have had to deal with the subject. Hence, then, the question of comparative merits amongst the different classes of construction of beams or girders is really narrowed to the method of connecting the top and bottom *webs* so called. In the tubular system, this is effected by means of continuous plates rivetted together; in the trellis girders, it is accomplished by the application of a trellis-work, composed of bars of iron forming struts and ties, more or less numerous, intersecting each other, and rivetted at the intersections; and in the girders of the simple triangular or "Warren" system, the connexion between the top and bottom is made with bars,—not intersecting each other but forming a series of equilateral triangles,—these bars are alternately struts and ties.

Now, in the consideration of these different plans for connecting the top and bottom *webs* of a beam, there are two questions to be disposed of—one is, which is the most economical? and the other, which is the most effective mode of so doing? But while thus reducing the subject to simplicity, it is of the utmost importance to keep constantly in mind, that any saving that the one system may present over the other, is actually limited to a portion or per centage of a subordinate part of the total amount of the material employed.

In the case now under consideration, namely, that of the Victoria tubes, the total weight of the material between the bearings is 242 tons, which weight is disposed of in the following manner:—

Top of Tube	76 tons.	
Bottom of ditto	92 ,,	
		158 tons.
Sides of ditto		84 ,,
Total		242 ,,

Assuming that the strain per square inch in the top and bottom is the same for every kind of beam—say 4 tons of compression in the top and 5 tons of tension in the bottom—the only saving that can by any possibility be made to take place being confined to the sides, must be a saving in that portion of the weight which is only about 34 per cent. of the whole. How, therefore, can 70 per cent. of saving be realised, as has been stated, out of the total weight, when the question resolves itself into a difference of opinion on a portion which is only 34 per cent. of such weight?

I am tempted to reiterate here much that was said by several experienced engineers on the subject, during the discussions already alluded to, at the Institution of Civil Engineers; but the argument adduced on that occasion could only be rendered thoroughly intelligible by the assistance of diagrams of some complexity, and I think sufficient has been said to demonstrate, that no saving *of importance* can be made in the construction of the roadway of the Victoria bridge, as it is now designed, by the substitution of any other description of girder. Yet, lest this should be considered mere assertion, permit me to adduce one or two examples, where the close-sided tubular system and the open-sided system may be fairly brought into comparison with each other in actual practice.

The most remarkable parallel case which occurs to me, is the comparison of the Victoria tubes under consideration, with a triangular or "Warren" bridge, which has been erected by Mr. Joseph Cubitt over a branch of the river Trent, near Newark, on the Great Northern Railway.

The spans are very similar and so are the depths. In calling your attention to the comparison, you must bear in mind that all possible skill and science were brought to bear upon every portion of the details of the Newark Dyke-bridge, in order to reduce the total weight and cost to a minimum.

The comparison stands thus.—

Victoria Bridge, as being erected.	*Newark Dyke-Bridge, as erected.*
Span, 242 ft.; weight, including bearings, 292 tons, for a length of 257 ft.	Span, 240 ft. 6 in.; weight, including bearings, 275 tons, for a length of 254 ft.

which shows a balance of 17 tons in favour of the Victoria tubes.

The Newark Dyke-bridge is only 13 ft. wide, while the Victoria tube is 16 ft., having a wider gauge railway passing through it.

This is a very important case, as the spans and depths are all but identical, and it will therefore enable you to form a judgment upon that point which has caused so much controversy at the discussion alluded to. It is true that in the Newark Dyke-bridge a large proportion of the weight is of cast-iron, a material I have frequently adopted in the parts of tubular bridges subjected to compression only; but from its brittle character I should never recommend it for exportation, not for the parts of a structure that are liable to a lateral blow.

It has been suggested that there is much convenience in the arrangement of the trellis or "Warren" bridge, as it may be taken to pieces and more conveniently and economically transported overland than "Boiler-plates." This may be correct under some circumstances, but it cannot hold good for a work like the Victoria bridge over the St. Lawrence.

I am aware that girders upon the "Warren" principle have been adopted in India, and I am not prepared to call in question the propriety of these applications in certain cases, but what I have been aiming at in these observations is, to prove to you that no economy over the plain tube can be effected in the case of the Victoria bridge. I may add, that it has sometimes been urged that the workmanship in trellis or "Warren" girders is of a less expensive character than that required in tubes. I am bound to confess my utter inability to understand such a statement; for, after many years of practical experience as a manufacturer of ironwork of every description, I do not know any class of workmanship that bears so small a proportion to the value of the material as boiler-plate work. If there be any difference in the cost, it ought certainly to be in favour of tubular beams.

Another example may be mentioned of a tubular beam, somewhat similar in dimensions to the last described, and one which is actually erected on a continuation of the same line of railway as that on which the Newark Dyke-bridge is situated, namely, over the river Aire at Ferry Bridge. Although the similarity is not so great with this as with the Victoria tube, yet I believe it is sufficiently so to form another proof that the advantage is in favour of the solid side.

As before:—

Newark Dyke Bridge.	*Ferry Bridge.*
Span, 240 ft. 6 in.; weight, 292 tons.	Span. 225 ft.; weight, 235 tons.

The difference between these weights is more than sufficient to compensate for the difference of span; besides which, in the Ferry bridge, made according to my designs and instructions, I was lavish in the thickness of the side-plates, and the bearings which are included in the above weight were stiffened by massive pillars of cast-iron.

For a further example, let me compare the Boyne trellis bridge (held by some to be the most economical) with the present Victoria tubes.

The Boyne bridge has three spans, the centre one being 264 ft., and the height is $22\frac{1}{2}$ ft. It is constructed for a double line of way, and is 24 ft. wide. The total load, including the beam itself, the rolling load at 2 tons per ft., and platform rails, &c., amount to 980 tons, uniformly distributed.

The bridge is constructed upon the principle of "continuous beams," a term which signifies that it is not allowed to take a natural deflection due to its span; but being tied over the piers to the other girders, the effective central span is shortened to 174 ft. In fact, this *principle* changes the three spans into five spans. Now the effective area given for compression in this centre span is $113\frac{1}{2}$ in., which gives a strain for the 174 ft. span of nearly 6 tons to the inch in comparison.

The Victoria tubes are so dissimilar in form and circumstances to the Boyne bridge, that it is a troublesome matter to reduce the two to a comparative state.

However, the Victoria tubes are known to be 275 tons in weight, 242 ft. in span, and of 19 ft. average depth, the strain not being more than 4 tons per in. for compression, with a uniform load of 514 tons, which includes its own weight, sleepers, and rails, and a rolling load of 1 ton per ft.

The Victoria bridge has not been designed upon the principle of continuous beams for practical reasons, including the circumstance of the steep gradient on each side of the centre span, and the great disturbance which would be caused by the accumulated expansion and contraction of such a continuous system of ironwork in a climate where the extremes of temperature are so widely apart; otherwise the principle alluded to was first developed in tubular beams, namely, in the Britannia bridge.

But since we are only now discussing the merits of the sides, let the Boyne bridge be supposed to have sufficient area in its top to resist 4 tons per in. (the proper practical strain), and let the spans be not continuous, it will be found by calculation that the area required at top will be 364 in., instead of 113½ in., and the weight of the spau would be found by calculation to come out little short of 600 tons, whereas it is now 386 tons; and if we suppose the Victoria tubes to carry a double line of way, and 24 ft. wide, with a depth of 22½ ft., even if we double the size in quantity, the whole amount of weight will be certainly very little more than 500 tons for 242 ft. span.

It will be necessary to conclude my remarks, with some further observations relative to the comparisons under our notice, which are of vital importance in considering the design of such a bridge as that to be erected for the Grand Trunk Railway of Canada.

Independently of the comparative weights and cost, which I believe have been fairly placed before you, the comparative merits as regards efficiency have yet to be alluded to.

You may be aware that at the present time theorists are quite at variance with each other as to the action of a load in straining a beam in the various points of its depth, and the fact is now known, that all the reccived formulæ for calculating the strength of a beam subjected to a tranverse load require remodelling. Therefore, at present it is far beyond the power of the designers of *trellis* or *triangular* bridges to say with precision what the laws are which govern the strains and resistances in the sides of beams, or even of *simple solid beams;* yet one thing is certain, which is that the sides of all these trellis or "Warren" bridges are useless, except for the purpose of connecting the top and bottom and keeping them in their proper position. They depend upon their connexion with the top and bottom webs for their own support, and since they could not sustain their shape but collapsed immediately they were disconnected from these top and bottom members, it is evident that they add to the strain upon them, and, consequently, to that extent, reduce the ultimate strength of the beams.

In the case of the Newark Dyke-bridge, when tested to a strain of 6¾ tons to the inch, its deflection was 7 in. in the middle, and when tested with its calculated load of 1 ton per ft. run, the deflection was 4⅜ in. The deflection of the Victoria tubes by calculation will not be more with the load of 1 ton per ft. than 1-6th in.; and we have had sufficient proof of the correctness of this calculation in existing examples. That of the Boyne bridge, with a uniform load of 530 tons, was 1-9th in., with the spans shortened in effect as described.

Many other bridges of similar spans to those above-uamed have been constructed upon the "open side" or "truss" principle, which are (in every sense of the word) *excellent* structures, but since no comparison of economy between them and the Victoria tubes has been offered, it would be improper to class them with those (already named) which have actually been put forward as examples of economy to a large extent over the tubular system.

As an argument in favour of the trellis beams, it has been stated, that no formula has been used to value the sides of a plate beam for horizontal strains; and, therefore, since the sides are thrown away except for the office they perform in connecting the top and bottom webs, it is asked why should more material be placed in the sides than sufficient for that purpose. Now I admit that there is no formula for valuing the solid sides for strains, and that we only ascribe to them the value or use of connecting the top and bottom; yet we are aware that from their continuity and solidity they *are* of value to resist horizontal and many other strains, independeutly of the top and bottom, by which they add very much to the stiffness of the beam; and the fact of their containing more material than necessary to connect the top and bottom webs is by no means fairly established.

It is also said that the "trellis" and "Warren" beams are usually made deeper in proportion to their span than the tubes, and therefore the straiu being less a less quantity of material is employed in the top and bottom webs. An important consideration should be named in reply to this—which concerns all the classes of beams alluded to—which is, that *any change of proportion in the figure of a beam changes the amount of strain caused by the load, and consequently changes the weight of the beam itself.* The resistance to horizontal strain in the above classes of bridges depends upon the distance between their top and bottom webs; such beams are said to vary in streugth directly as their depths and inversely as their spans. With regard to tubular beams a practical rule has been established, which determines that the depth shall not be less than 1-15th of the span; but although this is the minimum depth given, there is no reason to consider it the maximum depth; indeed, the tubular bridges just named are of a greater depth than that proportion would give. For instance, the depth of Ferry bridge is 1-11th of its span, and that of the Victoria tubes, next the centre opening, is 1-12th of the span. These proportions are, I believe, very similar to those that are usually adopted for "Warren" or trellis beams.

It is well known that the diagoual "struts" in these latter systems (when under pressure) deflect as if they themselves were beams; and any increase in the depth of the sides would be an increase of length in the "diagonals," which in the "Warren" must be compensated by an increase in their sectional area; aud in the trellis beam, if they are not increased in area, they must be iu number, so as to make more intersections. Therefore an increase in depth of the sides of these systems would not only be a proportionate increase in their weight, but would be an increase per square foot of their surface. Now the sides of a tube (from their nature) may be increased in depth up to a reasonable practical limit without any increase in their thickness.

Having given you my views with respect to the comparative merits of the different kinds of roadway, consisting of "beams," that may be adopted in the Victoria bridge, I now proceed to draw your attention to the adaptation of the "suspension" principle, similar to that of the bridge which has been completed within the last few months by Mr. Roebling, over the Niagara river, near the Great "Falls."

You are aware that during my last visit to Canada I examined this remarkable work, and made myself acquainted with its general details. Since then Mr. Roebling has kindly forwarded to me a copy of his last report, dated May, 1855, in which all the important facts connected with the structure, as well as the results which have been produced since its opening for the passage of railway trains, are carefully and clearly set forth.

No one can study the statements contained iu that report without admiring the great skill which has been displayed throughout in the design; neither can any one who has seen the locality fail to appreciate the fitness of the structure for the siugular combination of difficulties which are presented.

Your engineer, Mr. Alexander Ross, has personally examined the Niagara bridge siuce its opening, with the view of instituting, as far as is practicable, a comparison between that kind of structure and the one proposed for the Victoria bridge; and as he has since communicated to me by letter the general conclusions at which he has arrived, I think I caunot do better than convey them to you in his own words, which are subjoined below:—

"I find, from various sources, that considerable pains have been taken to produce an impression in England in favour of a suspeusion bridge in place of that we are engaged in constructing across the St. Lawrence at this place. This idea, no doubt, has arisen from the success of the Niagara suspension bridge, lately finished by Mr. Roebling, and now in use by the Great Western Railway Company as the connecting link between their lines on each side the St. Lawrence, about two miles below the Great 'Falls,' of the situation and particulars of which you will no doubt have some recollection. I visited the spot lately, and found Mr. Roebling there, who gave me every facility I could desire for my objects. Of his last report on the completion of the work he also gave me a copy, which you will receive with this. I have marked the points which contain the substance of his statement. I also enclose an engraved sketch of the structure. Mr. Roebling has succeeded in accomplishing all he had undertaken, viz., safely to pass over railway trains at a speed not exceeding 5 miles an hour; this speed, however, is not practised; the time occupied in passing over 800 ft. is 3 min., which is equal to 3 miles an hour. The deflection is found to vary from 5 to 9 in., depending on the exteut of the load, and the largest load yet passed over is 326 tons of 2,000 lbs. each, which caused a depression of 10 in. A precaution has been taken to diminish the span from 800 ft. to 700 ft., by building up, underneath the platform at each end, about 40 ft. in length intervening between the towers and the face of the precipice upon which they stand; and struts have also been added, extending 10 ft. further. The points involved in the consideration of this subject are, first, *efficiency*, and second, *cost*. These are, in this particular case, soon disposed of. 1st. We have a structure which we dare not use at a higher speed than 3 miles an hour; in crossing the St. Lawrence at Montreal we should thus occupy three quarters of an hour; and allowing reasonable time for trains clearing and getting well out of each other's way, I consider that 20 trains in the 24 hours is the utmost we could accomplish. When our communication is completed across the St. Lawrence, there will be lines (now existing, having their termini on the south shore), which, with our own line, will require four or five times this accommodation. This is no exaggeratiou. Over the bridge in question, although opened only a few weeks, aud the roads yet incomplete on either side, there are between 30 and 40 trains passing daily. The mixed application of timber aud iron in connexion with wire, renders it impossible to put so large a work to answer the purposes required at Montreal; we must, therefore, construct it entirely of iron, omitting all perishable materials; and we are thus brought to consider the question of cost; in doiug which, as regards the Victoria bridge, I find that, dividing it under three heads, it stands as follows:—

1st. The approaches and abutments, which together extend to 3,000 ft. in length, amount in the estimate to	£200,000
2ud. The masonry, forming the piers which occupy the intervening space of 7,000 ft. between the abutments, iucluding all dams and appliances for their erectiou	£800,000
3rd. The wrought-iron tubular superstructure, 7,000 ft. in length, which amounts to (About £57 per lineal ft.)	£400,000
Making a total of	£1,400,000

"By substituting a suspension-bridge the case would stand thus:—The approaches and abutments extending to 3,000 ft. in length being common to both, more especially as these are now in an advanced state, may be stated as above, at £200,000.

"The masonry of the Victoria bridge piers range from 40 to 72 ft. in height, averaging 56 ft., and these are 24 in number; the number required for a suspension-bridge admitting of spans of about 700 ft. would be 10, aud these would extend to an average height of 125 ft. These 10 piers, with the proportions due to their height and stability, would contain as much (probably more) masonry as is contained in the 24 piers designed for the Victoria bridge, and the only item of saving which would arise betweeu these would be the *lesser* number of dams that would be required for the suspension piers; but this, I beg to say, is more than doubly balanced by the excess in masonry, and the additional cost entailed in the construction at so greatly increased a height. Next as to the superstructure, which, in the Victoria bridge, costs £57 per lineal ft.,—Mr. Roebling, in his report, states the cost of his bridge to have been 400,000 dols., which is equal to £80,000 sterling. Estimating his towers and anchor masonry at £20,000, which I believe is more than their due, we have £60,000 left for the superstructure, which, for a length of 800 ft., is equal to £75 per lineal ft., giving an excess of £18 per ft. over the tubes, of which we have 7,000 ft. in length. By this data, we show an excess of nearly 10 per cent. in the suspension, as compared with the tubular principle, for the particular locality with which we have to deal, besides having a structure perishable in itself, on account of the nature of the materials; and to construct them entirely of iron would involve an increase in the cost which no circumstance connected with our local, or any other, consideration at Montreal would justify. We attain our ends by a much more economical structure, and, what is of still greater consequence, a more permanent one; and, as Mr. Roebling says, no suspension-bridge is safe without the appliances of stays from below, no stays of the kind referred to could be used in the Victoria bridge,—both on account of the navigation and the ice, either of which, coming in contact with them, would instantly destroy them. No security would be left against the storms and hurricanes so frequently occurring in this part of the world.

"No one, however capable of forming a judgment upon the subject, will doubt for one moment the propriety of adopting the suspended mode of structure for the particular place and object it is designed to serve at Niagara. A gorge 800 ft. in width and 240 ft. in depth, with a foaming cataract racing at a speed of from 20 to 30 miles an hour underneath, points out at once that the design is most eligible; and Mr. Roebling has succeeded in perfecting a work capable of passing over 10 or 12 trains an hour, if it should be required to do so. The end is attained by means the most applicable to the circumstances; these means, however, are only applicable where they can be used with economy, as in this instance."

My own sentiments are so fully conveyed in the above extract from Mr. Ross's letter, that I can add no further remark upon the subject, except perhaps that there appears to be a discrepancy in that part which relates to cost. In dividing the £80,000 into items, Mr. Ross has deducted £20,000 for masonry, and left the residue, £60,000, for the 800 ft. of roadway. Now it appears evident that this amount should include the cost of the "land-chains;" and assuming their value at about £15,000, there would be only £45,000 left for the 800 ft. of roadway, thus reducing the cost per lineal ft. to about that of the tube. But in the application of a suspension-bridge for the St. Lawrence the item £15,000 for "land-chains" would of course have to be added to the cost of 7,000 ft. of roadway, which would swell the amount per ft. to a little over that of the tubes.

In all that has been said respecting the comparative merits of the different systems of roadway you will perceive that a *complete wooden structure* has not been alluded to, because, in the first place, when the design for the Victoria bridge was at first being considered, *wood* was deemed not sufficiently permanent; in the second place, the structures alluded to in the report, as being inferior to that now in progress, are proposed to be constructed of stone and iron-work; and as a third reason, the construction of the tubular roadway is already so far advanced that any alteration, to the extent of abandoning *iron* and adopting *wood*, must involve monetary questions of so serious a nature as to render the subject beyond discussion, or even heing thought of in this Report.

In conclusion, therefore, I have to state to you my deliberate opinion that the present design now being carried out for the Victoria bridge is the most suitable that can be adopted, taking all the circumstances into consideration to which the question relates. In making this statement, I must ask you to bear in mind that I am not addressing you as an advocate for a tubular-bridge; I am very desirous of calling your especial attention to this fact, for really much error prevails upon this point, through the impression that in every case I must appear as an advocate; no one is more aware than I am that such inflexible advocacy would amount to an absurdity.

I entirely concur in what Mr. Ross says respecting the propriety of applying the suspension principle to the passage across the Niagara gorge; no other system of bridge building yet devised could cope with the large span of 800 ft., which was there absolutely called for, irrespective of the other difficulties alluded to.

Where such spans are demanded, no design of "beam" with which I am acquainted would be at all feasible. The tube, trellis, and triangular systems are impracticable in a commercial sense; and even as a practical engineering question the difficulties involved are all but insurmountable.

Over the St. Lawrence, we are, fortunately, not compelled to adopt very large spans; none so large, in fact, as have been already accomplished by the simple "girder" system. It is under these circumstances that the suspension principle fails, in my opinion, to possess any decided advantage in point of expense: whilst it is certainly much inferior, as regards stability, for railway purposes. The flexure of the Niagara bridge, though really small, is sufficiently indicative of such a movement amongst the parts of the platform as cannot fail to augment where *wood* is employed before a long time elapses.

I beg that this observation may not be considered as being made in the tone of disparagement; on the contrary, no one appreciates more than I do the skill and science displayed by Mr. Roebling in overcoming the striking engineering difficulties by which he was surrounded, I only refer to the question of flexure in the platform as an unavoidable defect in the suspension principle, which, from the comparatively small spans that are available in the Victoria bridge, may be entirely removed out of consideration.

I am, Gentlemen, your obedient servant,
(Signed) ROBERT STEPHENSON.

P.S.—In my last communication I stated, that in order to bring more clearly before you the comparative merits of different kinds of girders now very generally used for railway purposes, I had designed some experiments, and intended that the results should be contained in this report. They are in progress; but as they cannot be completed previous to my leaving this country for two months, I have been compelled to close my report without them.

(Signed) R. S.

Montreal, November 30th, 1855.

MY DEAR SIR,—Your favour of the 2nd instant, in reference to the Victoria bridge, I have received; and, in reply, I have to observe that the question of economy in the masonry is one which, in every point of view, had received from me the most mature consideration that my acquaintance with the subject, and the peculiarities incident to this locality, pointed out as necessary; and I shall endeavour to make clear to you, as shortly as I can, how far my opinions upon this subject are verified by the experience we have already had, both as regards the form and character of the design for efficiently answering its purposes, as well as the disposition of its leading features (*stone* and *iron*), with the view to the utmost practicable economy.

The various points referred to in your letter I shall take up in the order in which they occur. 1st. The abutments. These, it appears, are considered unnecessarily large, and more costly than the tubes, and it is suggested that they be reduced by making openings in, or by shortening them. These abutments are not in reality what, upon paper, they appear to be, a solid mass of masonry: *they are hollow*, each having eight openings or cells, 48 ft. in length and 24 ft. in width, separated by cross walls 5 ft. in thickness. The flank wall on the down-stream side, rising nearly perpendicular, is 7 ft. in thickness, and that on the up-stream side is sloping from its foundation upwards to an angle of 45°; its thickness is 12 ft., and presents a smooth surface to facilitate the operations of the ice, on which account its form had thus been determined; and to ensure greater resistance to the pressure of the ice, the cells are filled up with earth, stone, and gravel, so that one solid mass is thus obtained at a moderate cost.

The idea of introducing any other description into the abutments than those described is altogether inadmissible; passages through it where ice could accumulate would ensure its inevitable destruction upon the first hydraulic pressure it had to encounter.

I have observed in this immediate neighbourhood the effects of swift currents created by obstructions in the river on a recently formed causeway, constructed of timber, connecting a small island below the bridge with the shore, having openings about 12 ft. in width, at intervals of about 30 ft.

In the autumn of last year these openings were partly covered by heavy timber and planking strongly secured by iron work, and the consequence has been, that during last winter, the first crush of the ice, in forcing its passage through, destroyed every timber, plank, and bolt that opposed it—having got under it was immediately blocked up, and the pressure of water still forcing its way, the jam became at length so tight, that it burst with an explosion.

It is stated that the length of the abutments is unnecessary and greatly in excess. Upon paper this may seem so, and a recollection of the idea conveyed to my own mind subsequent to the earlier considerations of this subject, which led me to the conclusion of adopting their dimensions, prevents my attaching so much importance to such a view as I otherwise might do. You will recollect that the bridge is approached from the north shore by an embankment of 1,200 ft., and from the south shore of 800 ft. in length, the river being thereby narrowed to this extent; the waters, thus far embayed, have now to find their way through the bridge, and the current, overcharged with ice, sweeping its way along the front of the embankment into the nearest passage, attains ere reaching it a velocity which nothing but the most substantial masonry could resist. This, it will be seen, bears on the question of the length to which such masonry should extend, and I am more than ever convinced that I have not exceeded the limits which prudence dictates—thus confirming my original view in reference to this particular and very important point. I think you will readily admit that I have given ample reasons in justification of the extent of the abutments, bearing in mind that the form of *construction* contributes more to their apparent magnitude than a cursory glance at their appearance upon paper would justify one in supposing; and as to their cost, it is not to be supposed that the large and costly preparations made in machinery and other appliances for carrying on these works could, in fairness, be allowed to remain altogether unaccounted for, until redeemed by the slow progress of each succeeding pier. You will remember the consideration given to this subject at the time the contract details were under discussion, and I believe the most equitable adjustment was then arrived at for the mutual protection of both parties to the contract.

The two abutments have been proceeded with, and both have had their foundations (the most expensive parts) completed. The northern abutment, commenced last year, is finished to the level of 8 ft. above summer water level, and its extreme length for about 60 ft. in length is raised to the height of 20 ft. above that level, forming a slope to the embanked approach, which is (throughout its extreme length of 1,200 ft.) brought up to nearly the same level, and secured, I hope, for all time.

The south abutment is also finished to the height of 3 ft. above summer-water level, and secured for the winter. This abutment would have been nearly completed this summer, but for the unexpected depth of deposit, gravel, sand, and large boulders we had to clear out before reaching the rock, amounting to 8 ft. in depth more than we anticipated or had any reason to expect from our previous examinations and soundings. Next summer will enable us to finish this part of the structure, all the stone for which is prepared and now upon the adjoining land, covering several acres to the extent of three and four blocks in depth.

Next as to the piers. It is alleged that their depth is far greater than necessary. This, it appears, is on the assumption that they are 39 ft. deep in the shaft. A reference to the accompanying diagram of pier No. 5 disproves this statement; the depth, you will perceive, is only 33 ft. The tube requires a bearing surface of 21 ft., we have therefore only 6 ft. on either side. The idea of any reduction, therefore, at once falls to the ground; and even if such were admissible, your estimate of the value of such reduction is erroneous. This you will at once see when you consider that placing the first foundation stone in any one of these piers requires an outlay of from 55 to 60 per cent. of the total cost of each pier; there is, therefore, only about 2s. 6d. a cubic foot left for the remainder, and if any reduction had to be made, this rate would determine its just value.

It is true that in the arrangements for payments on account, a uniform distribution of the cost of each completed pier has reference to the masonry alone—a reasonable distinction being made between that above and below water level, the latter being paid for at a rate allowing of some remuneration for the previous outlay, at the same time reserving for that above such level a sufficiently ample allowance to ensure its completion.

The two large centre piers being alluded to, I would merely remark in reference to these, that they were designed as distinctive objects marking the navigable channel, that no reasonable ground for complaint on this account could be alleged; their ample dimensions also serve as a necessary protection against accidents incident to every navigation where it is possible to run against any obstruction existing within reach of reckless and unguarded steering. Although these reasons cannot be altogether overlooked, it has long since occurred to me that in breadth they might be diminished about 25 per cent., and such diminution I had in contemplation, provided any future observation in reference to the ice did not deter me from such a course. In regard to this I have further to observe, that these piers are in deep water where the ice does not ground, and where the pressure in consequence requires greater power of resistance; any diminution in these piers which I might, according to my own views of the case, be induced to adopt, I should treat as some compensation, as far as it went, for the increased depth of the foundations generally, which are found greatly to exceed our anticipations; although every pains had been taken to ascertain what these would be, we find in the progress of the works that the bed of the river in most parts is formed of large boulders heaped together in large masses, the interstices being filled up with gravel, sand, and mud, in many instances forming a hard concreted mass, and in others the reverse; beds of quick sand and mud being as frequent as any other. 3,000 tons of such material we had to clear out of the foundation of No. 5 pier, as you will see indicated on the diagram already referred to, below the level at which our previous examination would lead us to expect the foundation we sought. One of the boulders taken out, by admeasurement, would weigh about 11 tons; masses of 3 and 4 tons are strewed as thickly as pebbles on the sea shore. The shallows in the river are evidently formed by these deposits, and I have no doubt in every instance where these shallows appear we shall have to encounter similar difficulties. In pier No. 3 we found a depth of 4 ft. at one end, and 9 ft. at the other to clear out ere we reached the rock. These unlooked for contingents have materially retarded our season's operations, otherwise we should by this time have Nos. 3, 5 and 6 nearly completed, as it turns out we require another season to accomplish this. And here I think it well to observe that up to No. 6 inclusive, the expensive outlays have already been incurred; the dams have been completed, and in all except No. 4 the water has been pumped out and the machinery erected for setting the stone, but No. 5 is the only one where we have been able to complete any masonry, owing to the unlooked for causes I have already described. These contingents render it impossible to complete one pier in less than two seasons, though, as in the case of No. 1 pier, where no such unlooked for difficulty arose, the whole was begun and completely finished in one season, thus saving the removal and re-erection of all the machinery and appliances necessary, besides the reparation of such damages as the winter operations may produce.

With regard to the ice-breakers which is the next question referred to, the comparative cost between the detached or ordinary ice-breakers and those attached to the piers as in the present design, this question is easily disposed of. You will remember three years ago, when considering the mode of construction to be adopted, that in every point of view the plan of detached ice-breakers was found to be so far deficient in merit, both as to cost and efficiency, as to lead at once to its total abandonment. I shall endeavour in as few words as I can to recall to your recollection the reasons which led to this conclusion.

I was fully informed at the time of the mode described in the report you refer to, which contemplated the planting of very large cribs covering an area of a quarter of an acre each, and leaving a clear passage of 240 ft.; these islands (as they are called) of timber and stone were designed to have a rectangular well left open in their middle, out of which would rise the solid masonry towers supporting the weight of the superstructure. This enclosure of solid crib-work was intended to surround the masonry, yet detached from it, and receive the shock and grinding of the ice, yielding to a certain extent by its elasticity without communicating the shock to the masonry; and, if damaged, could be replaced with facility. They were designated also to reach the height of 30 ft. above summer water level, this being necessary on account of the great height which the ice generally attains; the up-stream face was intended to be sloped,—one of the primary requisites essential to the effectual performance of its duties. This mode of construction, you will readily perceive, comprehends very formidable dimensions, and it is only partially true, as stated, that it could be made available in serving as a coffer-dam for getting in the foundations of the masonry. The usual precautionary measures of clay-puddle would still be necessary to block out the water; and having already given you a description of the nature of the foundations we have to deal with, I need not now recount the difficulties which, under such circumstances, would present themselves.

You will also perceive that these quarter-acre islands would occupy 25 per cent. of the water-breadth of the river,—one of the most prominent reasons for their abandonment when first considered.

The space occupied by the piers as *being executed* is only 7 per cent.; this is a most important feature in the relative merits of the two modes of construction. Our present dams are generally about 5 ft. to 6 ft. above summer water level, and cover an area corresponding nearly with that described; latterly we have constructed them similar to these, filling the external barrier with stone and the inner with clay necessary to render them watertight: the force of the current is necessarily increased, and the natural consequence, owing to the fragile nature of the deposits forming the bed of the river, is to undermine rapidly the part exposed to the action of the waters, thus rendering them more insecure every day and requiring an immense amount of expensive labour for their protection. I mention these facts, which our experience has brought to light, as an additional reason why we should not resort to such an objectionable mode of construction. As to their cost, assuming the existing dams to serve the purpose as far as they go, we should have to raise them to the height of 25 ft. above their present level, and to add as much to their length up-stream as the necessary slope at that end would require.

These ponderous erections would measure about 350 ft. in circumference, and from their foundations to the top would measure 40 ft.,—25 ft. above the present dams. The wall thus formed of timber and stone would be about 20 ft. in thickness, the cubic contents of this mass above the level of the present dams would be 200,000 ft., and the masonry saved thereby would be exactly 20,000 ft., which is all that is required to form the stone cutwater or ice-breakers attached to the piers. I believe no man capable of instituting a comparison, and with *these facts before him*, will for one moment hesitate in giving the preference to the attached ice-breakers as now being executed; their more permanent efficiency, founded in every instance upon the solid rock, placed beyond the reach of any influence exerted by the currents, and their incomparable pre-eminence in relation to the space they occupy, together with their immunity from accidents (not requiring repairs of any kind), a light in which the other mode can never be regarded; and, lastly, although not least, their evident economy in the first cost places them immeasurably in the scale of merit beyond the temporary mode suggested as the substitute, on grounds which I think I have made clear are altogther untenable.

I believe I have now gone through the various points referred to in your letter, to which you called my particular attention, and I hope my explanations of the existing state of our operations will satisfy you that we have pursued the right course in the designing and prosecution of this work.

The only observation I would desire to add, would be in reference to the reasons which led to the adoption of 242 ft. as the span best suited in point of economy to fill up the space we had to deal with, although the masonry bears a larger proportion to the entire cost than a due regard to economy would appear to warrant, we find that to diminish the number of piers by one only on each side of the centre span, would in this item save 9 per cent., or about £50,000, whereas the spans would be thereby increased exactly 10 per cent., which would add 20 per cent. to the cost of the superstructure, as the proportion due to the sectional area of the tubes by this increase, which would amount to about £80,000.

The centre span is of course an exception, the reasons which determined this were local both as to height and width, and could not be departed from.

You will bear in mind that a clear height of 60 ft. is required at the navigable channel, a descent of 1 in 132 brings us to 36 ft. above such level at the abutments. The ice in December last year rose to within 8 ft. of this point, as you will see indicated on the diagram of No. 5 pier, and some hours before it reached this point it made a clear sweep of all our dams and temporary works surrounding the pier and abutments, although filled with stone and protected in all possible ways by sloped fronts on the up-stream side. In many statements which have been put forward great stress has been laid upon the fact of some one or two experimental crib ice-breakers fixed some short distance above the site of the bridge withstanding the shock of several winters' operations; I have seen these, and have observed the cause of their standing the test to be entirely owing to the fact of their being only some 2 ft. or 3 ft. above low water-level, and in shallow water, so that as soon as the waters rise they are covered over, and so completely loaded with the accumulating masses of ice, that they are firmly held in their places, their insignificance alone saving them from destruction; time, however, has swept *even these* away, and they are nowhere to be found.

In conclusion, I feel it my duty to state, that if, after having duly considered the subject, you still think a saving can be effected in any part of the masonry beyond what I have pointed out as possible in the centre piers, I shall make it my aim to carry it out to the fullest extent practicable.

And I am, dear Sir, yours sincerely,

(Signed) Alexander Ross.

R. Stephenson, Esq., M.P.

DESCRIPTION OF A SET OF SIX BLAST ENGINES MADE FOR THE EAST INDIAN IRON COMPANY.*

By Mr. Edward A. Cowper, of London.

In accordance with the request of the Council, that each member should communicate to the Institution the particulars of any work of a novel character in which he may have been engaged, and that would be likely to prove interesting or useful to the members, the following description of a number of Blast Engines that have been recently made for blowing the furnaces of the East Indian Iron Company has been prepared by the writer; and as so many of our friends are engaged in the production of that one metal, which not only

* Paper read before the Institution of Mechanical Engineers, Birmingham, Oct. 24, 1855.

exceeds any other in usefulness, but all the others put together, it is presumed that if the construction of these engines is approved, this paper will be of some service.

These engines were made to the plans and under the superintendence of Mr. Charles May, the consulting engineer to the East Indian Iron Company, by Messrs. James Watt and Co., to the drawings prepared by the author of this paper.

The engines are six in number, two pairs of them being intended to blow air at 2 lbs. per sq. in. as a maximum pressure, and the other pair to blow air at 4 lbs. per sq. in. as a maximum pressure.

The general form and construction of the engine is that of a "Pedestal or Table Engine;" the air-cylinder stands on a short pedestal, and itself forms the pedestal or table on which the steam-cylinder stands. The foundation-plate is 6 ft. square, and carries a wrought-iron crank-shaft in four plummer-blocks, having two light fly-wheels, one on each end of the shaft, and the two eccentrics for driving the air-valve, one on each side of the air-cylinder, and the eccentric for driving the steam-valve in the centre. The steam-piston has one piston-rod fixed in a short cross-head at the top, and this cross-head has two other piston-rods for driving the air-piston, which pass down outside the steam-cylinder through stuffing-boxes in the cover of the air-cylinder, and are attached to the air-piston. The long cross-head taking the connecting-rods to the cranks, is attached to the short cross-head by a pin, so as to allow a little freedom in case of unequal wear; the guides are attached to the steam-cylinder cover.

The air-valve is made under Mr. Archibald Slade's patent, and is a ring or crown-valve entirely enclosing the air-cylinder, and is not self-acting by the pressure of the air in any way, but is moved by the pair of eccentrics at the proper times, so as to give ample passage for the air to move with the greatest freedom, and the valve has such a proportion of lap as to cause the air to be compressed up to the working pressure before it is delivered, thus giving the engine no more work to do than is necessary.

The openings or passages for the air from the air-cylinder to the valve are extremely short, and the bars between the openings are made inclined, so as to cause a regular wear on the brass packing-rings which form the rubbing-face of the valve. The body of the air-valve is made of thin sheet-iron, neatly curved to two turned cast-iron rings, to which it is well secured by a great number of small bolts; these rings are bored out inside to receive the brass packing-rings before mentioned, which are secured in their places by bolts. There are no springs to the brass packing-rings, but they are bored out to be a perfect fit to the outside of the air-cylinder, and are then cut into eight pieces; and should any wear take place they can be at once adjusted, by introducing a thin sheet of paper behind them and screwing them fast in their places again. It should, however, be remarked that this valve is under totally different circumstances from any that have hitherto been made, as it is perfectly in balance, or rather it is suspended perfectly free, and slides up and down a turned cylindrical surface, and therefore there is no tendency or power to cause wear under any variation in the pressure of the air. The mode in which the two eccentrics drive the air-valve is by means of a "Gymbal Ring;" that is to say, there is a wrought-iron ring encircling the air-valve, and attached to it by two pins opposite each other, and the eccentric-rods are attached to the ring at two other points at right angles with the first: thus the air-valve is perfectly free.

The air-cylinder is 30 in. diameter and 2 ft. 6 in. stroke, and the piston makes 80 strokes per minute. The air-piston is packed with hemp packing, and has a ring to screw it down; the screws are so arranged that they can be got at by simply unscrewing small plugs in the cylinder-cover, when a socket-spanner can be introduced to screw the ring down. The air passes into the air-cylinder beyond the end of the valve, first at one end and then at the other, and is delivered into the hollow part of the valve, from which it escapes through two light copper branch pipes placed opposite each other, and having turned joints, fitting turned collars, fixed on the valve. The other ends of the pipes rest on a small surface or shelf prepared for them, and on which they slide backwards and forwards about 1-8th in.; these ends of the pipes are curved in the same manner as the other ends, so that the faces are in one plane, and the air-main has the faces of its branches surfaced to receive them; thus the air is taken equally from each side of the air-valve.

The steam-valve has considerable lap, and is so proportioned as to cut off the steam just after the half stroke and have a very free exhaust.

The boilers are on the Cornish plan, and will be chiefly used with wood as fuel, and the furnaces are made proportionately large for this purpose. The boilers are fed by a donkey-engine, entirely independent of the blast-engines, so that they are complete in themselves, and there is no fear of getting short of water whilst the blast-engines stand for "tapping," at which time, indeed, the boiler should always be fed, if only to keep the steam down a little.

The engines having to be transported some distance up the country, a limit of weight was given, viz., 1 ton for any one part of the engine; and, in accordance with this limitation, the total weight of a pair of these engines is only 11 tons as compared with 25 tons, the weight of an ordinary blast-engine of equal power; and the weight of the heaviest single piece of an ordinary engine is $4\frac{1}{2}$ tons as compared with 1 ton, the weight of the heaviest piece in the new engines. It is therefore evident that the engine can be moved with the greatest facility, and the first pair put to work here for trial simply stood on some balks of timber, and a few small bolts through the bed-plates were sufficient to hold them, and cause them to work quite steadily; whereas for the ordinary engine a strong building, with massive foundations, has to be erected.

The method by which a high speed for blast-engines has been attained is simply that of moving the air-valves for the air, having, of course, very large valves and passages, instead of letting the air itself move the valves. This arrangement, which was introduced by Mr. Slate to this Institution at the Meeting in July, 1850, at once prevents all blow and jar in the working, provided that the lap and lead of the valve are properly proportioned, and allows of the piston being driven at a high velocity, and, consequently, its diameter may be reduced, and its stroke shortened. This mode of working, combined with the fact of two engines working together as a pair, with their cranks at right angles, causes such uniformity in the flow of the blast that no regulator of any kind is needed; indeed the variation is hardly perceptible in a mercury gauge placed on a very short length of main; whereas the variation on the ordinary plan is very considerable, as shown by the indications in the diagram taken from an ordinary engine, which may be compared with that taken from the pair of small engines. The pair of engines are arranged to blow 3,600 cubic ft. per minute, and are speeded to 80 revolutions per minute, which, with 2 ft. 6 in. stroke, makes 400 ft. per minute, and this they do with the greatest ease and efficiency, owing to the exact manner in which the lap and lead, and area of passages, &c., are proportioned; but the author does not wish it to be supposed that he recommends a higher speed, or at all events a much higher speed, for although we have the example of locomotive-engines before us every day working at higher speeds, we also know something of the cost of repairs of locomotives working at high speeds, and it is evident that what an ironmaster wants is a good serviceable engine that will blow steadily on, day and night, without repairs and stoppages; in addition to these first requisites there are two other advantages which it is certain are attained by this construction of blast-engine, namely, first, great regularity of pressure in the blast, and secondly, greatly reduced first cost of engine and of foundations.

The CHAIRMAN said the engines appeared remarkably compact and small for blowing a furnace, and the uniformity of pressure obtained by them would be an important advantage. There had been a variety of plans advocated for obtaining a blast suitable to the different requirements of the cupola and the blast furnace; and he remembered that at a recent meeting of the British Association the subject had been discussed, and it had been proposed to use the fan for the blast-furnace. He understood that there was a furnace near Chesterfield blown by a fan, but he did not know the particulars of its application.

Mr. SAMUEL LLOYD, Jun., believed the great difficulty in using the fan for blowing a blast-furnace was to get pressure enough for that purpose, and he understood it had been found impracticable to obtain sufficient pressure of blast from the fan to force air enough into the furnace.

The CHAIRMAN observed that it had been argued on the other hand in favour of the fan, that the operations of the blast-furnace depended on the quantity of air delivered into the furnace, rather than upon the pressure at which it was delivered, and this view of the question was, he believed, more generally entertained now than previously, but he had not heard the results of the practical trial of the fan for blast-furnaces. He mentioned that a number of blowing-machines of different constructions were to be seen at the French Exhibition, showing a great amount of skill and ingenuity; in one of them, the general plan of the machine was much the same as that described in the paper, having an upright cylinder like that shown in the drawing, with a very large flat slide-valve working on each side for the admission and discharge of the air.

Mr. COWPER observed that there was a great practical advantage in the engines described in the paper, from the air-valve having no side pressure whatever upon it, as it was a circular valve entirely surrounding the blast-cylinder, and consequently was perfectly in balance; and being guided very steadily, by fitting the cylinder at top and bottom, its motion was very smooth, and the wear upon it would be very slight.

Mr. SAMUEL LLOYD, Jun., inquired whether the small engines were to be worked with high-pressure or low-pressure steam; in the use of high-pressure blowing-engines he had known some difficulty to be experienced in keeping up a regular blast, owing to the steam-pressure being occasionally let down in the night; but a low-pressure engine was not liable to that objection. In the present case of a pair of engines blowing together, one might be worked high-pressure and the other condensing with the same steam, and saving a large proportion of the fuel.

Mr. COWPER replied that the engines had been designed specially for lightness, to meet the peculiarity of the situation for which they were intended, and they had therefore been made non-condensing, cutting off at half-stroke, with 50 lbs. steam; but wherever the circumstances admitted of it, he would certainly make high-pressure expansive and condensing engines, so that great economy of fuel would be obtained.

Mr. SAMUEL LLOYD, Jun., remarked that in the case of a single blowing-engine the use of a fly-wheel was objected to, as it was then found that the blast was less steady than without the fly-wheel.

Mr. COWPER observed that this must necessarily be the case with a single engine, as the fly-wheel, by making the crank-shaft revolve uniformly, caused the motion of the piston to be faster at the middle than at the ends of the stroke; but in the ordinary single engines, without a fly-wheel, the motion of the piston was regulated by the resistance of the air, and, consequently, it remained much more uniform throughout the stroke, causing less fluctuation in the supply of air to the main. A fly-wheel was only applicable when two blowing-engines were coupled at right angles to one another, but even then the full advantage of the engines being coupled could not be obtained except by a quick-stroke small engine, such as those described in the paper, where the intervals between the successive discharges of air into the main became so small (amounting to less than a quarter of a second) that no appreciable fluctuation of pressure was produced, although the ordinary regulator or reservoir was entirely dispensed with.

The CHAIRMAN observed that this regularity of the blast was a great advantage, and gave an important superiority over the ordinary engines; the same advantage would apply still more completely to the fan-blast, if it were found capable of producing sufficient pressure, and he should be glad to know the exact particulars of its application to blowing-furnaces.

Mr. SAMUEL LLOYD, Jun., remarked that one difficulty in applying the fan to blowing-furnaces would arise from the circumstance, that it was sometimes requisite to employ a higher pressure and smaller tuyeres for a time, in order to clear the furnace when it had got out of order; this could be readily effected with blowing-cylinders, by increasing the steam-pressure, when required, for that purpose.

Mr. Cowper said that a different treatment was requisite for blowing a blast-furnace and for a cupola; for blowing a cupola, experience had led him to prefer the fan to a cylinder blowing-engine; he was aware that a heavier pressure had been advocated for the cupola, but he had found a large quantity of air blown through 10-in. tuyeres better for that purpose than a higher pressure with smaller tuyeres; but for blowing a blast-furnace, he did not think the fan would give pressure enough to force air into the centre of the furnace at all. He remembered that a plan had been suggested by Mr. Buckle, at a former meeting of the Institution, for increasing the pressure of the fan-blast, by using two or three fans, one blowing into the other, making them all push together, so as to increase the pressure successively, the last one only communicating with the furnace.

Mr. Sampson Lloyd remarked that the great improvement effected in the last few years in the quantity of iron obtained from blast-furnaces was mainly attributable to the increased quantity of air blown into them: a few years ago, 40 tons of iron per week was the general yield of a furnace, but this was gradually increased up to 80 and 100 tons, and now, 150 to 200 tons per week might be obtained from a single furnace, which was as much as was given by four or five furnaces formerly. He thought it would be impossible to force in the supply of air necessary to obtain this quantity of iron by means of the fan, and he understood it had been given up at the furnaces near Chesterfield that had been referred to.

Mr. Clift inquired what was the power of the pair of blowing-engines described in the paper, and the quantity of air they would deliver.

Mr. Cowper replied that they were capable of working up to 34 indicated H.P. each, and delivering together 3,600 cubic ft. of air per minute, at a pressure of 4 lbs. per sq. in.

Mr. Clift remarked that it had been proposed to use Jones's Gas Exhauster as a blowing-engine, using four of them together, working one into another, in order to get sufficient power; he was not aware that they had been so used in this country, but he believed they were employed to a considerable extent in Sweden, where they were driven by water. This machine was very simple and portable in construction, and he had found it work very satisfactorily in discharging gas; from an experiment that had been made with the exhauster, it appeared that a steam-engine of 5 nominal H.P. would force 80,000 cubic ft. per hour of coal gas, or about 1,300 ft. per minute.

Mr. Cowper said that he had obtained a pressure of 10 to 15 in. of water, or about $\frac{1}{2}$ lb. per sq. in., with a large fan blowing a cupola with two 10 in. tuyeres; but that $7\frac{1}{2}$ in. (or about $\frac{1}{4}$ lb. per sq. in.) was what he had generally adopted for cupolas and smiths' fires.

Mr. W. A. Adams observed that he had heard of a fan at Messrs. Cubitt's works, in London, running, he believed, at 2,000 revolutions per minute, by which a considerably higher pressure than usual was obtained. A great pressure might be obtained by using three such fans combined, the one fan blowing into the aperture of the other; this plan had been tried by Mr. F. J. Bramwell, and found to answer, the pressure indicated by the last fan being nearly three times that of a separate fan.

Mr. Henry Maudslay said he had not seen the fan at Messrs. Cubitt's, but understood that a pressure of 16 in. of water was obtained with it; it was a Lloyd's silent fan, 3 ft. diameter, and worked quite silently.

The Chairman observed that Schiele's fan, which was much used in Manchester, was also a noiseless fan; it was worked at a very high speed, making 2,000 to 3,000 revolutions per minute. He proposed a vote of thanks to Mr. Cowper for his paper, which was passed.

REVIEWS.

Papers and Practical Illustrations of Public Works of Recent Construction, both British and American. London: Weale.

We see with pleasure (and make it the first point in our notice) this instance of presenting, in fraternal juxta-position, the records of professional works of our own countrymen and those of our transatlantic cousins. The subjects of the articles, both British and American, in this collection, are all of present interest, involve much science and technical knowledge, and convey much practical information. The engravings given in the volume extend to the number of fifty. These afford the advantage of illustration to most of the subjects of the ten different papers of which the collection is composed, and are excellent specimens of both draughtsmanship and engraving.

In the order of the arrangement of the different articles, the *pas* is given to the American—that is, "A Memoir of the Niagara Falls and International Suspension Bridge," by John Roebling, C.E., of the United States.

Mr. Roebling's very instructive paper we consider an important contribution for the use and assistance of the profession, and, at the same time, highly interesting to the general reader. Into the moderate space of ten pages he has compressed a history of the undertaking, facilely intelligible and truly amusing to the general reader; also, a description of the extraordinary work itself, which must be highly useful to professional men.

Still more important to the engineer, Mr. Roebling next, in another ten pages, gives an analysis of this most extraordinary work, and, with much candour and liberality, presents the profession with a practical account of its various parts, in the same course in which they are put up. He then gives no less than twenty-two illustrations of the various parts and progress of the works, with figured dimensions in most cases, and, indeed, capable of being used as working drawings. He then, in seven more pages, furnishes details of consequences and results observed and obtained since the structure was completed, fully and satisfactorily explaining points of deep interest to all concerned, or likely to be so, in works involving so deep a responsibility. These he arranges under the following heads: Effects of heavy loads—Effects of temperature—Effects of high winds—Effects of the trotting of horses or cattle, or the marching of men.

In an appendix of seven more pages, Mr. Roebling gives—A table of quantities—Contents of masonry—The Specification for the work: and adds some of the proposals and contracts, or sub-contracts, for the portions of the work, the subjects of arrangements of that nature. Of so much interest do we consider Mr. Roebling's description of the undertaking that we must contribute some extracts, feeling assured that our readers, especially professional ones, will be pleased to hear so enterprising a brother speak for himself.

"The success of this extraordinary bridge, the Niagara Falls International Suspension Bridge, is now to be considered an established fact. The trains of the New York Central, and of the Great Western Railroad, in Canada, have been crossing regularly since the 18th March, 1855, averaging thirty trips a day.

"The bridge, of a span of 821 ft. 4 in. from centre to centre of towers, forms a slightly-curved hollow beam or box of a depth of 18 ft.; width of bottom, 24 ft., and of top, 25 ft. It affords two road-ways,—an upper and a lower. The lower floor is used for common travel: the upper floor is appropriated to railway business and side walks. The two floors are connected by two trusses of a simple construction, so arranged that its resisting action operates both ways, *up* as well as *down*.

"There are 624 suspenders, each capable of sustaining 30 tons, which makes their united strength equal to 18,720 tons. The ordinary weight they have to support is only 1,000 tous. A locomotive of 34 tons weight, including tender, spreads its weight by means of the girders and trusses over a length of no less than 200 ft. Of course the greatest pressure is under the engine, but it is there supported by no less than twenty suspenders. If by any accident a sudden blow or jar should be produced, the strength of the suspenders will be abundant to meet it. The pressure of an engine and of a whole train of cars is so much distributed that the depression caused by an ordinary passenger train is not readily observed.

"The elevation of the bridge above the river is 245 ft.

"In the brief space of one month the bridge has become one of the greatest thoroughfares on the continent of America."

Having thus concisely described the work as now standing, he introduces some important information and observations on the question of suspension bridges for railway transit. He says:—

"The practicability of suspended railway bridges of large spans was a question of great importance to America, intersected as it is by numerous large rivers and deep gorges at a depression far below the general surface of the surrounding country. Again, to preserve free and unobstructed the navigation of the great rivers of the United States to be crossed by railways demanded a new class of viaducts, such as will safely pass the locomotive with its train at one bound, and at an elevation that will leave no obstruction to the sailing and steaming craft below. The great rivers of this continent will no longer offer insurmountable obstructions to the formation of uninterrupted lines of railways."

Mr. Roebling the alludes to some of the immense railway works and suspension bridges going on in America under other management than his own. He states that "A railroad is now being constructed through the central part of the State of Kentucky, known as the Lexington and Darville line, which, with the extension to the State line of Tennessee, will form the connecting link between two great networks of railways, north and south, of such an immense extent as can only be found in the North American continent. This important connexion will have to be abandoned, if a suspension railway bridge of a single span of 1,224 ft., now in course of construction across the Kentucky river, which there forms an abrupt chasm 300 ft. deep, cannot be accomplished. On the completion of the first road to the Pacific (which will run at right angles, or nearly so, with the road above alluded to), we shall possess continuous lines of rail, from east to west, of more than 3,000 miles in extent, on which, if desirable, cars loaded with treasure at San Francisco may be passed to New York without breaking bulk."

"The Kentucky river, the Niagara, and many others, which have been ploughing their courses through limestone formations, will not admit of any other mode of crossing than by a suspension bridge. Tubular, as well as arch and truss bridges, are in those localities impracticable."

On the subject of the cost of railways in America, and contrasting it with the expense in Europe, he says:—

"Whilst the European engineers are engaged in the construction of short lines of railways at such enormous cost that, in most cases, the capital invested yields no remunerative dividends, the task of the American engineer is to lay down thousands of miles, with extensive bridging, at a cost which would barely suffice in Great Britain to cover the expenses of preliminary proceedings."

Mr. Roebling then says, emphatically:—

"The work which I had the honour to have entrusted to my charge has cost less than 400,000 dollars,—less than £80,000. The same object accomplished in Europe would have cost one million of pounds, without serving a better purpose or insuring greater safety. It is the mixed application of timber and iron in connexion with wire which renders it possible to put up so large a work at so small a cost."

There are nine other articles in the collection, all good, and of considerable importance, but we have found so much of interest in the remarkable undertaking, the subject of Mr. Roebling's paper, that we have exhausted all the space we can afford in this Number. We shall, however, return to the other subjects on the next occasion. In the meau time we may premise that there are four papers, by Mr. Hawkshaw, on as many viaducts constructed by him, viz., the Paddock viaduct, the Lockwood viaduct, the Denby Dale viaduct, and the Tithebarn-street viaduct;—a paper by Mr. Joseph Cubitt, on the Newark Dyke Bridge, Great Northern Railway;—another American Article, by Mr. Charles Elliott, of the United States, on the Mountain Top Track in the State of Virginia;—and an extremely interesting Memoir of the late Brigadier-General Sir Samuel Bentham, an engineer of great originality of invention and design, both military, naval, and civil; the interest in whom must be much increased by the recollection that he was the affectionate brother of the late celebrated jurist and philosopher, Jeremy Bentham, and that the Memoir is written by the General's talented widow, Lady Bentham.

CORRESPONDENCE.

PLANS FOR TAKING THE THRUST OF THE SCREW.

To the Editor of The Artizan.

Sir,—Seeing, in the recent Numbers of The Artizan, sketches and descriptions of the plans used by the best known engine-builders of Great Britain for transmitting the "thrust" of propeller-shafts in direct-acting engines, with your promise to continue the subject, a desire to aid in the endeavour to remove a constant source of anxiety and annoyance to builders, as well as engineers, induces me to send you drawings and descriptions of two plans, which have been tested by the most prominent engine-builders of this city. Their introduction by you to the notice of the British members of the "craft" may lessen our obligations for information on screws and screw-engines derived from them through your pages.

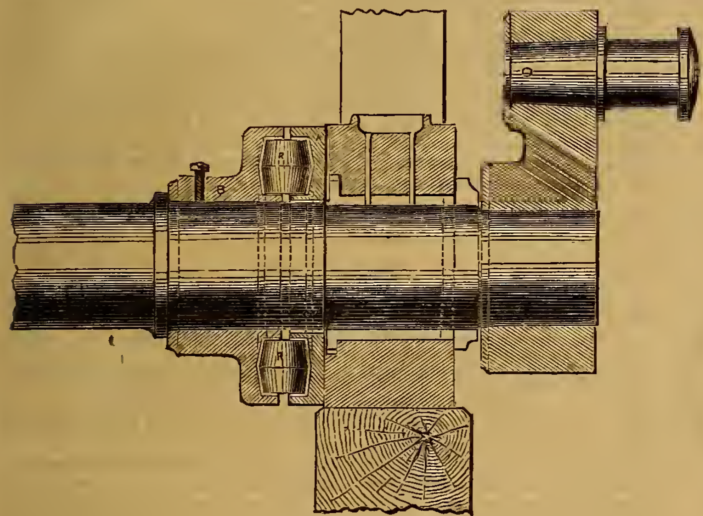


Fig. 1.

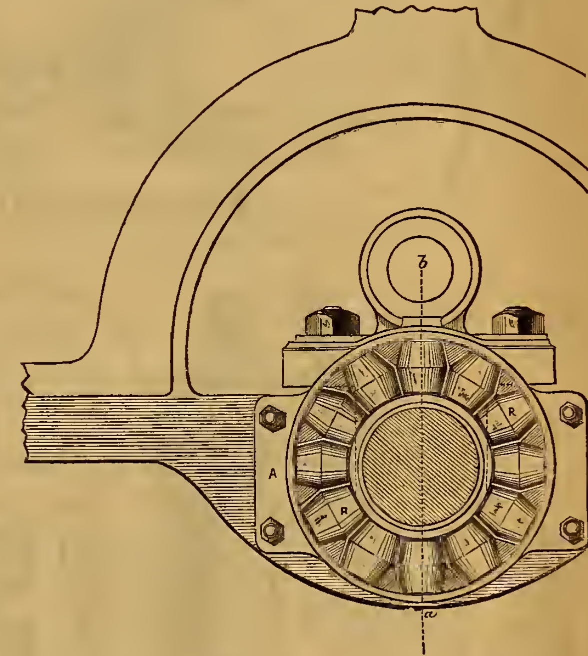


Fig. 2.

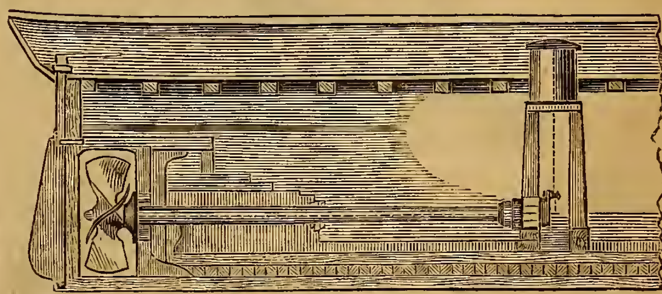


Fig. 3.

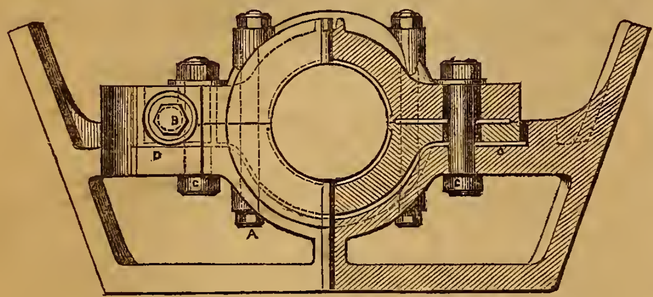
No. 1. "Parry's Anti-friction Box," Figs. 1, 2, and 3, was designed and patented by G. L. Parry, a mechanic of this city, for railroad turn-tables, but was subsequently applied by him to taking the thrust of propeller and other shafts. It consists of two cast-iron blocks (marked A and B on sketch), each having a shallow V-shaped annular groove, turned out to form a track, in which the rollers, R, R, travel. A is bored out a little larger in diameter than the part of the shaft over which it fits, and is bolted through lugs to the main bearing of the engine, or any other bearing possessing the requisite stability, that may be found more suitable, from its presenting better facilities for adjustment in the line of the shaft. B is fitted to the shaft against a shoulder, and secured by a set screw or a key.

The rollers are made of cast steel, accurately turned to fit a gauge, and then hardened. Their shape is that of a double truncated cone, whose sides form an angle equal to that formed by the sides of the groove in which they roll; consequently, their bearing extends from end to end. In practice, more clearance space than that shown in the drawing is given between the ends of the cones and the surrounding flanges, to avoid the possibility of contact between them, if the cones should slue, in consequence of slackness in the boxes, arising from a want of proper adjustment. This plan has been modified, but not improved, by turning the grooves in wrought-iron rings, which were then case-hardened, and let into recesses made for them in the cast-iron blocks; but this, in addition to increased first cost, had the greater objection of rapid wear, due to the exfoliation of the wrought iron. Cast steel, properly tempered, would probably be the best material for the purpose, but no tests of its fitness have been made. Cast iron, of a close grain, is proved to work well, by a trial on the steam-tug *America*, at work on the Delaware river for two years past. This boat is of our largest class, and is fitted with two condensing-engines, having cylinders 40 in. diameter by 30 in. stroke, working at a steam-pressure of 22 lbs. per square inch. Her route is from Philadelphia to the Capes, where rough weather is frequently encountered, causing a variable thrust upon the shaft, which must test, in the severest manner, a machine with loose working parts. Her engineer speaks in a very favourable manner of its efficiency, and reports the engines as making from five to six revolutions more per minute, when the thrust is received by it, instead of broad collars.

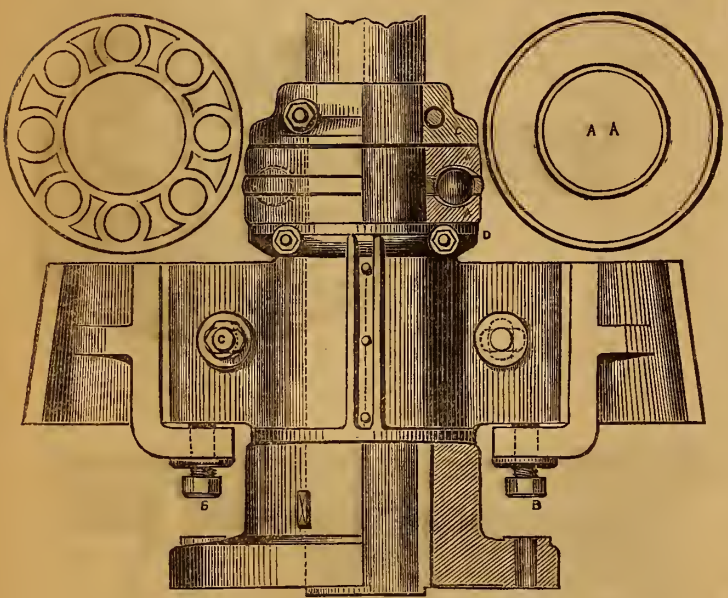
Parry's Box has been fitted to the tugs *Huron*, of Boston, *Uncle Sam* and *Cushing*, of Philadelphia, and to the steam-packet *City of Boston*. The first one fitted to the latter vessel did not work well, in consequence of the block, B, not having proper adjustment, which permitted the cones to slue. There being an insufficient amount of clearance between the flanges and the ends of the cones they came in contact, when small portions of the cast iron were chipped off and got amongst the cones. These, with the sluing of the cones, prevented their rolling freely, or at all, several of them having facets of half an inch in width worn upon the opposite surfaces, clearly showing the sliding motion that had taken place. The thrust was originally transmitted by "the collar thrust-bearing" fitted to the after engine pillow-block, but, on repairing the engines, Parry's Box was substituted, and, on the first voyage afterwards, although the cones were in a disordered condition, the engines made between two and three revolutions more per minute than they had with the first arrangement—an improvement of about four per cent. A second box was placed in her, which works to the satisfaction of her engineer.

The steamer *North Carolina*, lately sunk by collision, near Holyhead, on her voyage hence to Liverpool, was also fitted with Parry's Box.

No. 2 (see sketch), known as the "Ball-driver," may be considered a modification of Parry's Box, the difference being the substitution of spheres for cones, and of a groove hollowed out to a circle, whose radius is greater than that of the spheres, instead of a shallow **V**. It has the addition of a light skeleton frame of brass, whose function is to keep the



BALL DRIVER.



BALL DRIVER.

balls equally distributed around the shaft, and from contact with each other. This frame is deemed so necessary by the designer, Mr. J. B. Kirk, that he has applied for a patent, which will most probably be granted to him. In some cases, on small boats, the grooves have been made in the broad flanges, marked C and D on the sketch, in the fore side of the driving collar, and on the after side of the bearing. The first machine made to test the plan was fitted in that way, with balls of cast iron, carefully moulded and put in just as they came from the foundry. Its performance has not been excelled by more elaborated machines, and but one reason exists for a departure from its style, and that is, one of the collars should be made free to revolve independently of the shaft, in case of a ball splitting or crushing, when the pieces might jam the machine. When such an event takes place, the grooved collar rotates against the bearing, performing, as well as is usual, with "broad collar bearings." This has occurred in one or two instances, and about ten minutes were required to remove the broken balls and put the machine in working order again, but *minus one ball;* for, unless a spare ball of the same diameter as those at work in their places could be had, it would be useless; for, if larger, all the pressure would come upon and soon crush it; if smaller, it would only, after a certain time, receive a portion of the pressure: that is, after the original set had worn to the size of the new ball. The rings should be in halves, bolted together to save time and labour in removing them, instead of a continuous piece, as shown in the sketch, and of *chilled cast iron.* The greatest wear takes place on the balls, but usually does not amount to much if the grooves are in good order. Those of hardened cast steel sometimes split, through the cracks received in cooling them, scarcely perceptible at first, but gradually extended by the kneading action to which the balls are subjected, until the solid metal left yields to the strain with a warning report. Cast-iron balls of hard metal appear to be well adapted; no finishing is needed; and should one break, an entire new set could be put in at a less cost than a single ball of cast steel.

The "Ball-driver" has been fitted to several tug-boats, large and small—viz., the *Portland, May Queen, Grant, Chase, Decatur,* and others; to the iron steam-barge *H. L. Gaw*, steam-packet *City of New York*, and to the U. S. steamer *San Jacinto.* In the event of its failure on the latter vessel, provision was made to transmit the thrust by broad collars working against wide flanges cast on the brasses of the bearings; but they have not yet, to my knowledge, been needed, the "Balls" having worked admirably;—in a voyage from Boston, U. S., to Southampton, England, no appreciable wear being evident.

These two plans are submitted without an expression of preference for either. It may clearly be shown, by the laws of mechanics, that the exterior cone must *drag*, and cause the axis of the rollers to become tangents to circles drawn around the centre of the shaft, whose diameters vary with the thrust on the shaft and the condition of the rubbing surfaces. One case has come to the notice of the writer, in which the outer cones were reduced by wear, in twelve months' time 5-16ths of an inch in diameter,—thus

When first put in the cones were alike.

It is acknowledged, by the advocates for the Parry Box, that it requires lubrication at periodic intervals, which, alone, in the absence of other evidence, would prove that a pure rolling motion does not take place. A committee, appointed by the Franklin Institute, have tried some experiments upon a steamer where the thrust could be taken either by the box or by broad collars, and have reported a gain in favour of the box; and a board of U. S. naval engineers have reported, from results of trials made with and without the box, a very marked superiority for the box. No official trial or report has been had with the Ball-driver; but some of the engineers having charge of them give their unqualified approval, while others condemn them. So, too, of the Parry Box, many engineers pronounce it the best in use, while others oppose it. Where the work has been properly fitted, and the materials good, both work well; when deficient in either of these essential qualities, failure has resulted.

Respectfully yours, &c.,

WASHINGTON JONES.

Philadelphia, January 21st, 1856.

To the Editor of The Artizan.

D. J. HOARE'S IMPROVEMENTS IN SCREW PROPELLERS.

[We have received the following letter, which we have much pleasure in laying before our readers, having had several inquiries for the results of Mr. Wylde's experiments, promised in our last Volume at pp. 219, 270.—ED.]

SIR,—Having been requested by D. J. Hoare, Esq., to forward you a statement of the results I have obtained in investigating his plan of angular propulsion for screw-propellers, I have the pleasure of laying before you the following remarks and experiments:—

Mr. Hoare proposes, by arranging the propeller-shaft at an angle of about 30° with the horizon, to obtain an increase of speed—without an increase of power—over that resulting from the horizontal plan, now adopted.

By analogy, we may infer that some such result would accrue, as a similar principle is involved in towing on canals, in trimming the sails of vessels, in the construction of windmills, in the fins and tail of a fish, &c.; but the chief cause of the advantage obtained in the case of the screw by this arrangement, is, that *both blades* would be immersed, and worked against a more dense body of water than could be obtained by the horizontal plan, at present used, as in that arrangement the upper blade works close to the surface of the water, having little or no fulcrum, and leaves the lower one nearly all the work to do. Mr. Hoare, by his angular plan, obviates this difficulty, as my experiments seem to demonstrate.

On thinking over this fact, I am inclined to believe, that, were it mechanically possible, the horizontal screw and driving-shaft would, by virtue of these inequalities of action, have a tendency to assume an angle with the horizon or direction of the vessel, which would be a general resultant of all the operating forces; and that this angle would be one from which the most beneficial results would be obtained in the application of the propelling force.

To test these suggestions, a boat was fitted with clock-work and a propeller, and every care was taken to ensure uniform and reliable result.

On driving this by the horizontal plan, I obtained, as a mean of many trials:—

Distance run.	Time.
40 ft.	$20\frac{1}{2}$ seconds.

Power of clock expended.

I took this as a standard of the horizontal plan.

The machinery was then elevated so as to take together, with the driving-shaft and axis of the screw, au angle of 30° with the horizon, the bows, mid-ships, and stem, having the same immersion as in the former experiments. The results obtained were, as a mean:—

Distance run.	Time.
40 ft.	$17\frac{1}{2}$ seconds.

Power of clock-work not quite expended.

Now, these results are a proof of the soundness of the principle; but, in in these experiments, no just increase of resistance was obtained which would bear a proper ratio to the comparative submersion of the propeller of the model and that of a large vessel. In the experiments this did not exceed an inch, whilst, in practical application, the increased submersion would be some feet, tending, of course, in the latter case, to afford a fuller and more decided result of the conditions of the proposed improvement; in fact, on applying this principle on the large scale, BOTH blades would, at the angle proposed, work against a solid body of water (if we may use the expression), and the resistance to each blade being thus equalised, we should obtain an increase of speed with the exertion of the same power over that from the horizontal plan, just in proportion as this equalisation of the action of the blades is carried out. It would also follow that the vibration of the vessel would be lessened, and the situation of the screw would leave the rudder in such a position as to be beyond any influence of the back water.

I am, of course, unprepared to offer any remarks as to the mechanical obstacles which exist in the application of this plan; these, of course, are subjects for the shipbuilder's consideration; but it certainly seems that, by a judicious application of this new plan, combined with recent improvements in the construction of vessels, a great advantage in speed may be obtained, and an economy of working expenses effected.

I am Sir, your obedient servant,

JAMES WYLDE, Jun.,

Professor of Natural Philosophy, &c.

Royal Polytechnic Institution,
February 14, 1856.

BOILER EXPLOSIONS.

To the Editor of The Artizan.

SIR,—In your November Number, page 255, I read an account of an explosion at the Kibblesworth Colliery. The remarks made with reference thereto I perfectly agree with, and I consider that there is occasionally something connected with the working of steam boilers, by which the most careful engineer may be hurried into eternity without any apparent or timely warning. I wish to acquaint you with what took place under my own observation in the year 1854, when I happened to be in partnership in a small engineering establishment. We had an engine of about 7 or 8 H.P. to drive the machinery, and a boiler (about 10 H.P.), of what is commonly termed Trevithick's or the Cornish boiler.

I placed the most careful man in the works to attend to this engine and boiler, knowing that in case of an explosion in such a country (as I was then in) would be a death blow to our success in business. I used to visit the stoke-hole aud examine the float-gauge very often, and everything went on well for some weeks; but in passing through the stoke-hole one evening after dusk, I smelt something very unusual, and I called the engine-driver, and asked him what was the cause of it. He, however, could not tell, but informed me that he could not get the engine up to her speed.

The first thing I did was to examine the float-gauge to ascertain if there was sufficient water in the boiler. I tried it three or four times, and to all appearance there was quite sufficient water; and I should remark that the float-gauge had never deceived me before. Whilst examining it, however, to my great surprise I discovered that the hemp that had been placed round the float wire was on fire. I have to state that this float wire had no stuffing-box, but merely passed through a small hole in the boiler plate, and had a lead ball placed ou it, and a little hemp placed between the ball and the boiler to prevent the escape of steam. As soon as I saw the hemp ignited I knew that there was danger, and as the engine driver was going to open the suction-cock for feed-pump, I stopped him, and took the wrench off in case any other person should open it. I ordered him to draw the fire instantly, and on examining the crown of the boiler, I found it to be almost blood-red. I continued working the engine on the rarified air or gas until it had all been exhausted.

The most singular thing connected with the affair was the action of the float. I never could account for it. In a case of this kind the best engine-driver might be deceived, thinking that he has plenty of water in his boiler, as indicated by the float, and at the same time he has none.

I am afraid I am taking up too much of your valuable space, and beg to subscribe myself as

Your most humble, obedient servant,

THOMAS MERITON.

Rostock, January 29, 1856.

WORKING STEAM EXPANSIVELY IN MARINE ENGINES.*

The following reply to the letter of "FACTUS," in our December Number, has appeared:—

I pass over the second paragraph without remark, further than that I perfectly agree with the writer. With respect to the third, I can only say that I am sorry that any difficulty should have been found in understanding me, and as I am invited to correct the writer if wrong, I will at once proceed to do so, when I think it will appear that every practical man might reasonably be supposed to see the force of my reasoning.

I have nothing to say as to the data upon which the supposed engines of 400 H.P. are constructed, nor do I doubt but that $3\frac{1}{4}$ times the nominal H.P. would be obtained in engines of good construction; but I think that the coal consumed per indicated H.P. is usually much nearer 5 lbs. than 4 lbs. Certainly the average consumption of steamers of all classes is above this, and 5 lbs. is usually allowed in calculating the capacity of the coal bunkers. 4 lbs. would give only 60 tons as the cousumption in 24 hours instead of 66; but I believe that 75 would be consumed in most cases.

With respect to cutting off at 5-8ths, I am quite aware that it is done in numerous instances, but I still think that the more usual practice is to cut off at 3-4ths.

If "FACTUS" had read my paper attentively he would have seeu it stated, in several places, that I considered the boilers might be reduced in something like the proportion of the consumption of fuel; but that to avoid complicating the tables, as also to allow of more easy firing, I supposed the boilers to remain the same, notwithstanding the engines were increased in size.

With respect to "all the other parts of the machinery" being retained, I need hardly say that it would of course be necessary to regulate their sizes to the increased size of the cylinders; but I stated that the nominal H.P. being increased to double would not increase the weights to a greater extent than 50 per cent.

"FACTUS" has apparently confused himself in reading my paper;—he says, "a good engineer would take the *best* examples, and not the good, bad, and indifferent for a *mean*." Of course he would, if he wanted to show what the *best* results were; but these best examples are the ones in which the very principles I have advocated have been partially carried out.

Setting aside the question of reducing the boilers, the principles I recommend to be *always* carried out are actually put in practice during the time an ordinary engine is working with expansion gear, the engine then being larger in proportion to the power than when working at full power. I, of course, do not propose to reduce the indicated power now used in vessels, but I say that what I want to see *always* done with ordinary engines, *is* done when they are working expansively.

To illustrate this, I suppose a vessel fitted with 400 H.P. engines, and that it were determined, from any cause to reduce them to 200 H.P.; I would then let the engines remain, so far as the cylinders are concerned, reduce the boilers, and work the steam expansively, cutting off at about 1-4th, and thus reducing the consumption (if the engines were ordinary ones, and not the best, already working very expansively), nearly 1-3rd.

With respect to "FACTUS'" objection to my taking the *Termagant* and *Simoom* as examples, I would say that he is quite at liberty to do so, as they were put down from published particulars, merely to show that 3-4ths of a square foot of floor-space per nominal H.P. was a fair allowance. I feel sure the best examples will give this as the space occupied.

In answer to the inquiry as to what extent I propose to reduce the 4 lbs. (or, according to my notions, 5 lbs.), say $4\frac{1}{2}$ lbs., I would state that I believe it may be reduced to about 3 lbs. when the steam is cut off at 1-4th, and perhaps to $2\frac{1}{2}$ lbs. when cut off at 1-7th. I should not expect these results except the cylinders be carefully covered.

Lastly, I do not know what "FACTUS" means by the theory in dispute being a decided step backward. What theory?

I agree with him that economy can be obtained in the boiler by increasing the pressure, but he surely cannot mean that using high-pressure steam, and cutting it off at 5-8ths, is sufficient to obtain all the economy possible.

I do not agree with him that it would be desirable to dispense with condensation; and although I look forward with interest to the return of the high-pressure boats, yet he will find that little or nothing has been done in economising fuel, for the simple reason that the steam is not worked expansively enough (the cylinders being too small), and the advantage of condensation being disregarded—and for what?—to save the weight and space occupied by an air-pump and condenser.

I am, yours, &c., EDWARD E. ALLEN.

OSCILLATING ENGINES.

To the Editor of The Artizan.

SIR,—Seeing the extensive use of the oscillating engine for steam-vessels, may I inquire the objections which prevents its adoption for turning heavy machinery on land, where the advantage of firm foundations are favourable? The most weighty objection I have heard urged, is the steam passing through the trunnions, the heating of which, Dr. Ernst Alban says, increases the friction considerably. I shall be glad to be further informed on this subject. Your attention is respectfully requested by a subscriber.

PROGRESS.

P.S. I have been informed cast iron bearings have been used with advantage.
Manchester, February, 1856.

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* See THE ARTIZAN, Vol. xiii., pp. 240, 261, 289, 294.

POSITION OF BRINE DISCHARGES.

To the Editor of The Artizan.

Sir,—Can you kindly allow me space in your very valuable Journal to ask some of your *naval* engineer readers, I mean some who really do "go down to the sea in ships," a practical question relative to the proper management of the marine boiler.

My question is—What, in their opinion, is the best position for the mouth of the internal *brine* of surface blow-off pipe?

Having been engaged these many years back in fitting out steam-vessels, I have found no little diversity of opinion on this point. As a matter of course, I have my own notions on this subject, but I should like to draw out the practical experience of some of the many intelligent officers who have had charge of steam-boilers at sea. I should like to know whether my notions are in accordance with sound practical experience or opposed to it.

I am, Sir, a constant reader, Factus.

HIGH-PRESSURE STEAM: ITS GRADUAL DEVELOPMENT IN THE STATIONARY ENGINE.*

We are not surprised at the extensive and growing use of high-pressure steam; on the contrary, it does appear a matter of surprise that, seeing its vast importance and great economy, it has grown into favour so slowly.

James Watt was thoroughly acquainted with the properties of heat; but its great economy, when in a state of high tension, he never had the means of practically testing. The investigations into the *laws* of *latent* heat, as demonstrated by Watt and Black, are noble bequests to science.

It is not to be wondered at that the steam-engine, as it came from the hands of Watt, with all its vast improvements, which, in the point of economy, reduced the cost of fuel from 17 lbs. of coal per H.P. per hour to 4 lbs., we say we do not wonder that its grand feature, condensation, almost sacredly associated with *Watt,* should be loved and cherished by those who implicitly follow in the *wake* of a great and original mind.

We shall treat, 1st, of the construction of the boiler; 2nd, its mountings; and, lastly, its management.

We would not be dogmatic in recommending any peculiar style of boiler, but would state, from long experience, that the multitubular boiler is decidedly the best and most economical. We have also found, from long and carefully recorded experience, that the following are the best proportions for a tubular boiler.

About ¾ of a sq. foot of fire-grate surface per H.P.
" 20 sq. ft. of heating surface in the tubes "
" 16 in. of area through the tubes "
" 12 in. in the chimney, or over the bridge "

We would note that the actual or indicated H.P. obtained from such a boiler will be at least three times the nominal, and may be pressed to 60 lbs. or 70 lbs. on the square inch.

We would also remark that the vexed question of smoke consumption is so largely mixed up—in fact, is so much a question of boiler construction, or size, that we have no hesitation in saying, that where there is plenty of boiler power there will be no smoke; and instead of turning to the many patent nostrums now before the public for smoke consumption, we would seriously advise our engineering readers to turn their attention to the proportions of their boilers, and to add to them where pressed; we will promise them *greater economy* and *no smoke.*

Flat surfaces, such as tube-plates, should be stayed every 12 in. for a pressure of 40 lbs., and every 9 in. for 60 lbs. up to 80 lbs. on the sq. in.; and we would advise that they should be tested with cold water to a pressure double the working pressure.

2ndly. The mountings of a tubular boiler should consist of a good stop-valve, capable of being opened and shut with a screw. Two safety valves, whose united areas should be equal to the main steam pipe, one of these valves fitted so as to be opened or shut by the attendant, the other to be out of reach. One gauge-glass, with three cocks on the front, and within the reach of the stoker, a feed-cock, with small donkey or feed-engine, close beside the boiler, and a blow-off cock within sight of the gauge-glass. We have no confidence in the float, and would dispense with it altogether.

Lastly, its management. And while we are writing this, the "Times" of the 16th January has been put on our table, containing an account of a boiler explosion in Staffordshire, at Lea Brook, near Tipton, attended by a sad loss of human life. The investigations by the coroner's jury have only elicited the fact that great ignorance prevailed amongst the attendants.

Now, in the name of the profession, we would protest against the twaddle which is generally written by non-professional writers in the newspapers on these subjects, and tell them that there are two, and only two, causes to which boiler explosions are traceable—namely, want of water, and imperfect safety apparatus.

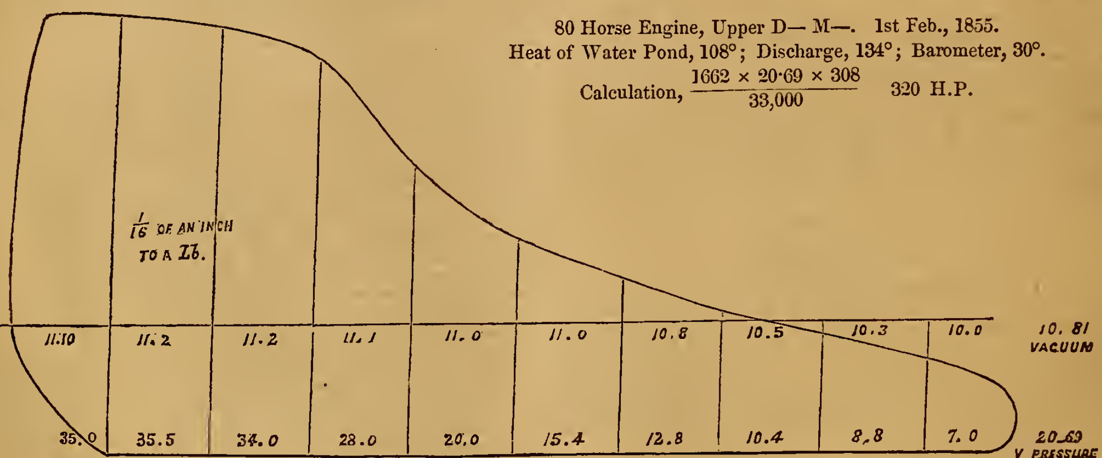
It would be dangerous to send a chaw-bacon or a school-boy into a druggist's shop to dispense our medicines. We hold it to be equally dangerous to put boilers into the hands of ignorant and careless attendants.

Without going into detail, we would assert that when a boiler is well made, well mounted, and well cared for, it will not explode: as proof of this, we have only to state that during the last twenty-four years we have had really very few casualties in our locomotives, although many of their boilers are pressed up to upwards of 100 lbs. on the square inch. We have now to add the experience of the last year's campaign in the Baltic and Black Seas, with five block ships, and a large number of gun-boats, all of them carrying over 60 lbs. on the inch in their boilers.

We have no desire to see *Government* supervision and control extended, but we are strongly impressed with the fact that soon we will have to recommend that the public, in order to protect the factory *owners* and *employés* themselves, will have to seek legislative interference, to place a responsible person or persons in our towns and manufacturing districts, to supervise the whole question of boiler management and safe construction. To manage a tubular boiler well and safely requires the constant attendance of a stoker who knows his work, and who will take care that he never has less than 2 or 3 inches of water over his tubes and furnaces; and who also knows that if by any chance his boiler should run short of water, he is to draw his fire, and try all means of stopping the evaporating power of the boiler, before he puts water on red-hot plates or tubes.

2ndly. The Engine—The stationary beam engine. We would approach its noble proportions with reverence,—it is associated in our early days with all that is great and majestic. Nevertheless, we have had strange doubts and misgivings that it is now out of date; we have been gradually convinced that its ponderous beam, columns, and entablature may be dispensed with, and that, by laying the cylinder on its side, and keeping the same length of connecting rod, we gain in *fewness* of parts and in *simplicity;* and such an engine will only require a tithe of the masonry required for the beam engine. We have seen, from actual experience, that when pistons have been well made, the *wear* on a horizontal cylinder is quite as equal as in a vertical one; but the whole subject of the stationary engine with high-pressed steam is in a transition state.

(To be continued in our next.)



80 Horse Engine, Upper D— M—. 1st Feb., 1855.
Heat of Water Pond, 108°; Discharge, 134°; Barometer, 30°.

Calculation, $\frac{1662 \times 20{\cdot}69 \times 308}{33{,}000}$ 320 H.P.

* From the "Engineering Journal."

NOTES AND NOVELTIES.

The Strike in the Shipbuilding Trade.—As both the masters and men concerned in this dispute still continue to adhere to their original resolutions, their differences are as far from being made up as ever. A number of joiners belonging to other places reached the town this week, and commenced work upon the terms laid down by the employers; and, altogether, the prospect of any of the hands now on strike being ever re-engaged again is more than doubtful. Indeed, the firm of Messrs. William Denny Brothers, which was the one most affected by the strike, have at present within ten of their full complement of joiners, and over the whole of the departments there is not a deficiency of above 150 hands, compared with the number employed before the strike. The total number employed here at present is about 800.—*Dumbarton Herald.*

Large Purchase of Steam-Ships for France.—On Saturday, Feb. 9, the purchase was made, of the General Screw Steam Shipping Company, of the *Jason, Indiana, Golden Fleece, Calcutta, Argo, Queen of the South, Hydaspes*, and *Lady Jocelyn*—amounting, we hear, to nearly £500,000. We believe this to be the largest purchase of shipping ever made in one line, and it has been effected by Mr. Graham (of the firm of Maitland, Cuthbert, and Co., of Paris), Mr. Brett (of the firm of Cunard, Brett, and Austen, of London), and M. Beraud Villars (manager of the French Clipper Company).

Important to Captains.—The Board of Trade supply the captains of vessels gratuitously with wind and current charts, sailing directions, forms for registering temperature, height of barometer, and, in some cases, with instruments of the best class, on condition that the captains make as regular and complete observations as possible of the direction, duration, and force of winds, &c., which they experience during their voyages. By this arrangement —which is made in concert with a similar one under the direction of the American Government—the captain has the best materials at his command for the various calculations necessary to secure a rapid and safe voyage; while, with ordinary diligence and observation, he can furnish the most valuable information to those whose business it is to sit at home, and by collecting the observations of many voyages, work out results of the utmost value to navigation, as well as to general science. The charts and sailing directions supplied to captains are those published under the direction of Lieut. Maury, and which embody the observations hitherto made under the auspices of the Washington Observatory, with regard to the winds which prevail during the various seasons of the year throughout the different tracts of ocean.

Telegraph to Australia.—"The Genoa Corriere Mercantile," of the 5th ult., has the following:—The Mediterranean Electric Telegraph Company, which is at this moment occupied in laying down the necessary wires to unite the island of Sardinia with La Calle, on the coast of Africa, intends to establish a complete telegraphic communication between Europe and Melbourne, in Southern Australia. After opening secondary lines between La Calle, Bona, Bugia, Algiers, and Oran, the company proposes to run the principal line by Tunis, Tripoli, Alexandria, Cairo, Suez, Jerusalem, Damascus, Bagdad, Bussorah, along the northern coast of the Sea of Oman, Hyderabad, and Bombay, where the line is to separate into two branches. The northern branch will proceed directly to Agra, whence a wire will be directed towards Lahore and Peshawur, and thus reach within a short distance of Cabul and Cashmere. From Agra the telegraphic line will pass through Benares and unite at Calcutta with the southern branch, which, starting from Bombay, will pass through Bangalore and Madras. From Calcutta the line will follow the north-east coast of the Gulf of Bengal, the peninsula of Malacca, the Sunda islands, and thence cross over to the north of Australia, and, extending along the eastern coast of that continent, communicate with its numerous settlements, until it ultimately reaches Port Adelaide. The entire length of the line is estimated at 20,000 kilometres.

Iron Girders, Axles, and Shafts.—Mr. James Fenton, of Low Moor, Yorkshire, has patented a mode of manufacturing axles, piston-rods, and shafts, girders, and other like articles, by rolling up or coiling a plate of iron, of any required thickness and size, into a compact roll or coil; next bringing it to a welding heat in a suitable furnace, and then drawing it to the required shape under a hammer; or by passing it, when at a welding heat, through a pair of rolls. The welding may be carried completely through or only partially, say half, through the mass; if the latter, a compound axle or other article will thus be formed, neither solid nor hollow, which it will be nearly impossible to break. The mode of operating is as follows:—A plate of iron is prepared, of a suitable length, width, and thickness to form a compact roll or coil, containing sufficient metal for the production of the intended axle or other article. The thickness, and consequently the other dimensions of the plate, will depend upon the quality of the iron employed. This plate is heated to a red heat (when needful), and two or more workmen, with tongs or pincers, turn up one of the edges; hammermen then bend down this turned up edge on to the side of the plate, so as to form the commencement of a roll or coil; after which the operation is continued in the same manner until the whole of the plate has been rolled up; and it may then be passed through a pair of rolls, if considered necessary. A compact roll or coil of metal being thus produced, it is heated to a welding heat in an air or other suitable furnace, and then welded and drawn down under a hammer to the required form. The welding and shaping of the axle or other article may also be performed by passing the roll of metal, when at the welding heat, between a pair of rollers, having sets of grooves of gradually decreasing diameter, in the manner commonly practised when rolling bars and rods of iron; or the roll or coil may be submitted first to a hammering process, and then passed between grooved rollers until it is reduced to the required shape. The plate of iron employed for forming a coil or roll which is to be manufactured into an axle or other like article, may be a compound one—that is, it may be composed of iron of different qualities, and in this case the plate should be so rolled up as to bring the iron of superior quality at the outer surface. In some cases, also, a small solid or hollow core or centre may be employed, and the plate of iron may be coiled around it, until a mass has been produced of sufficient size for the production of the intended axle or other like article. The process of manufacture is then concluded as above directed. The patentee claims "the mode of manufacturing axles, piston-rods, and shafts, girders, and other like articles, by rolling up or coiling a plate of iron into a compact roll or coil; next bringing this roll or coil to a welding heat, and then drawing it to the required shape under a hammer, or by passing it between rollers, or by a combination of hammering and rolling processes."—*Mining Journal.*

Improvements in Forging Iron.—Mr. W. Clay has recently taken out a patent for an improved method of manufacturing forged iron, the chief object being the economisation of the metal in the manufacture of bars, shafts, &c. In manufacturing large shafts, or similar articles, lengths of wrought-iron, of a zigzag form, are piled together, to admit of their locking into each other, and forming together a hollow cylinder. This cylinder is filled with sand, charcoal-dust, and other suitable granulated substances, to form a core, and the ends being closed by welding-plugs, the cylinder is brought to a welding heat, and subjected to the action of the hammer, for the purpose of uniting the several parts together. The claim is for making shafts, or other articles, of wrought-iron, by piling together suitable lengths, and the employment of a core as described.—*Ibid.*

Moulds for Metallic Castings.—Mr. E. Cooke, of Balsall Heath, near Birmingham, has, during the past week, specified his patent (through Mr. George Shaw), for improvements in moulds used in casting certain parts of metallic furniture. This invention relates to the stocks or moulds used in casting the corner blocks, and other cast pieces of metallic bedsteads, and other articles of metallic furniture, such as chairs, sofas, and couches. The stocks or moulds consist of two or other number of dies, connected together by hinges or otherwise, which are, when used, made to embrace the pillar, or rod, or part on which the block or other piece is to be cast. The melted metal being poured into the stock or mould is cast upon the pillar, rod, or part. The before-mentioned stocks or dies are commonly made by the ordinary process of casting in sand, and require to be finished by filing, and other manual processes. This invention consists in making the stocks or moulds, by casting the same in metal moulds, whereby the finishing required when they are cast in sand is unnecessary, they being sufficiently true for use without the usual finishing and fitting. The inventor describes and represents, in his specification, a method of making stocks or dies for casting ornaments upon two crossing rods, such as are used in the head and foot rails of metallic bedsteads, which method consists as follows:—He forms a die or mould, having an internal figure corresponding to the external figure of one of the stocks or moulds. A mould of the ornament, which it is wished to cast upon the crossing rods, is fixed upon a plate, and placed against the face of the mould. A plate of metal, provided with a channel for pouring the melted metal into the mould, is next placed against the plate carrying the mould. The three parts of the mould are then fastened together by screws or otherwise. Fused cast-iron is poured down the before-mentioned channel into the mould, the air escaping by passages in the upper part of the mould. On taking to pieces the mould, the casting occupying the interior of the same constitutes a stock or mould. A pair of these stocks or moulds is made to embrace the rods, upon which the ornament is to be cast. Melted metal is poured in, and fills the cavity in the moulds, thereby casting the ornament upon the crossing rods. This invention is also applicable to the production of stocks or moulds for casting corner blocks, and all those parts of metallic furniture, to the casting of which stocks or moulds are, or may be, applicable.—*Ibid.*

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 29th September, 1855.

2170. Henry Bernoulli Barlow, Manchester—Improvements in mules and other machines of the like nature for spinning and doubling cotton, and other fibrous materials. (A communication.)

Dated 15th October, 1855.

2301. John Micklethwaite, Leipzig—Improvement in propelling and steering vessels

Dated 16th October, 1855.

2309. William Cotton, Loughborough—Improvements in the manufacture of looped fabrics.

Dated 24th October, 1855.

2375. James Smith, Liverpool—Improvements in apparatus for giving alarm signals, and for extinguishing fires.

Dated 14th November, 1855.

2572. Alfred Vincent Newton, 66, Chancery-lane—Improvements in the construction of locks. (A communication.)

Dated 15th November, 1855.

2577. George Lister, Leamington—A cooling apparatus to be used in brewing.

Dated 16th November, 1855.

2584. William Cooke, 49, Frederick-street, Gray's-inn-road Improved apparatus for cleaning knives and other cutlery.

Dated 21st November, 1855.

2624. William Cooke, 49, Frederick-street, Gray's-inn-road —Improvements in gas and solar light reflectors.

2698. George North, Lewisham-road, Greenwich—Improved portable apparatus for supporting and folding heads, tilts, coverings, and awnings of wheel carriages, marine vessels, goods, and ways.

Dated 23rd November, 1855.

2641. Augustus Dacre Lacy, Hall house, Knayton, near Thirsk—Machinery or apparatus for agricultural purposes, to be used in combination with stationary steam-power.

Dated 24th November, 1855.

2647. John Elce and George Hammond, Manchester—The employment of a new material in the manufacture of wicks for moderator lamps.

Dated 27th November, 1855.

2672. Edward Peyton and Duncan Morrison, Bordesley Works, Birmingham—Improvements in the construction of metallic-bedsteads, and other articles to sit or recline upon.

Dated 29th November, 1855.

2695. James Egleson Anderson Gwynne, Essex Wharf, Strand —Improvements in instruments for indicating pressure or vacuum.

Dated 3rd December, 1855.

2717. Frederick Walton, Wolverhampton—Improvements in papier-maché trays.

Dated 4th December, 1855.

2725. William Hartcliffe, Salford—Improvements in weighting the top rollers of machinery used in preparing and spinning cotton and other fibrous materials.

Dated 7th December, 1855.

2765. William Inlam Ellis, Salford—Improvements in the slide valve or valves of steam or other motive-power engines.

Dated 10th December, 1855.

2780. John Hall, jun., Mount Pleasant, Walmersley, near Bury—Improvements in jacquard looms.

Dated 11th December, 1855.

2795. John Horsley, Cheltenham—Certain means of treating quinine and iodine, and other mineral medicines, in order to cause them to combine with cod liver oil, or any other fish oil, or with seed oil.

Dated 12th December, 1855.

2805. Robert W. Davis and Daniel Davis, Yellow Springs, Greene, Ohio—Improved vice.

2807. Isaac Beardsell, Huddersfield—Improvements in the finishing of mohair cloths and other textile fabrics, and in the machinery employed for that purpose.

2809. Robert Midgley and George Collier, Halifax—Improvements in preparing worsted, mohair, alpaca, cotton, and other yarns.

2811. Richard Holben, Barton, Cambridgeshire—Improvements in apparatus for chopping barley.

Dated 13th December, 1855.

2813. John Roberts, Falmouth—Improvements in machinery for moulding bricks and tiles.

2815. Alphonse Louis Poitevin, Paris—Improved photographic printing.

2817. James Murdoch, 7, Staple-inn—A process for separating the oleine from the stearine of fatty and oleaginous bodies, and for the extraction of oil from oleaginous grains and from olives. (A communication.)

2819. John Little, Glasgow—Improvements in heating and cooking apparatus.

2821. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in apparatus for containing compressed air or gases, and in the application of the same to the obtainment of motive-power. (A communication.)

Dated 14th December, 1855.

2823. John Walter Friend, Freemantle, Southampton—Improved registering log and deep-sea lead.

2825. Alfred Krupp, Essen, Prussia—Improvements in railway and other wheels, and in the method of, and machinery for, manufacturing the same.

2827. Charles John Todd and Robert Pinkney, Long-acre—A balance pen.

2829. Peter Haworth, Manchester, and Alexander Forrest, Birmingham—An improvement in the manufacture of belts, bands, braces, and other similar articles of wearing apparel.

Dated 15th December, 1855.

2831. Leonard Clayton, Unsworth, Lancaster—Improvements in machinery for dressing yarn.

2833. John Aspinall, Limehouse—Improvements in machinery for curing sugar and extracting moisture therefrom, parts of which are applicable to separating liquids and moisture from substances containing the same.

2836. George Coats, Glasgow—Improvements in horseshoes and in attaching the same to horses' feet.

2837. Agnes Wallace and John Wallace, Nether-place, Bleach Works, Renfrew, N.B.—Improvements in bleaching, washing, or cleansing textile fabrics and materials.

2838. Samuel Twist, Birmingham—Improvements in casters for furniture and other purposes.

2839. William Clay, Liverpool—Improvements in the manufacture of bar-iron.

2841. William Clay, Liverpool—Improvements in the manufacture of iron and steel.

Dated 17th December, 1855.

2843. Samuel Fletcher Cottam, Manchester—Improvements in mules for spinning cotton and other fibrous materials.

2845. Charles Bracegirdle, Congleton—Improvements in the manufacture of bolting cloths employed in dressing flour.

2847. John Lobb Jeffree, Blackwall—Improvements in or additions to furnaces.

2849. Frederick William East, 185, Bermondsey-street—Improvements in waterproofing and enamelling textile and other fabrics, in imitation of and to be used in lieu of leather, and for other similar purposes.

2851. William Sangster, Cheapside—Improvements in the manufacture of stays and corsets.

2853. William Hemsley, Melbourne, Derby—Improvement in the manufacture of elastic pile fabrics.

2855. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in ships' tillers. (A communication.)

2857. William Wilkinson, Nottingham—Improvements in machinery employed in the manufacture of looped fabrics.

Dated 18th December, 1855.

2859. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improved harvesting machine. (A communication.)

2861. Christopher Nickels, Albany-road, Surrey, and James Hobsor, Leicester—Improvements in the manufacture of pile fabrics.

2863. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of manufacturing wrought-iron cannon. (A communication.)

2865. Alfred Vincent Newton, 66, Chancery-lane—Improvements in washing machines. (A communication.)

2867. Frederick Robert Augustus Glover, M.A., Bury-street, Saint James—Improved instrument or apparatus for taking angles, and measuring lines, surfaces, and solids, and ascertaining the variatiou of the needle.

Dated 19th December, 1855.

2869. Joseph Cartwright, Hyde, Chester—Improvements in taps or valves.

2871. Richard Ruston, Birmingham—Improvements in the construction of anchors, and appendages to be used therewith.

2873. Josiah Sanders, Bristol—Improvements in trusses for supporting parts of the human body.

2875. George Harvey, Charlotte-street, Portland-place—Improvements in portfolios.

Dated 20th December, 1855.

2877. Robert William Sievier, Upper Holloway—Improvements in guns and pieces of ordnance, and the projectiles thrown from them for the purposes of war.

2879. James Fleming, jun., Newlands-fields, Renfrew, N.B.—Improvements in bleaching, washing, cleansing, and preparing textile fabrics and materials.

2881. Evan Evans, South Wales—Improvements in combining and fixing railway bars.

2883. Philip Antrobus, Chepstow—Improvements in preserving and packing flour.

2885. Alexander Charles Louis Devaux—King William-street—Improved machinery for crushing and grinding vegetable and other substances.

Dated 21st December, 1855.

2887. David Dunne Kyle, Albany-street, Regent's-park—A method of communicating motion.

2889. John Watson, Glasgow—Improvements in the manufacture or production of articles of ladies' dress.

2891. Bernard Hughes, Rochester, New York, U.S.—A mode of mingling the vapour of bi-sulphuret of carbon and steam, and applying them as a motive-power.

2893. Charles James Appleton, Manchester—Improvements in machinery or apparatus for knitting. (A communication.)

2895. Edward Tyer, Cornhill—Improvements in telegraphing or communicating by means of electricity.

2897. Charles Glover, Lincoln—Removing snow from a line of railways.

Dated 22nd December, 1855.

2901. James Newman, Birmingham, and William Whittle, Smethwick—Improvements in the manufacture of hooks and eyes, and in machinery to be employed in the manufacture of the hooks aforesaid.

2903. William Stevenson and William Crawford, Lochwinnoch, Renfrew, N.B.—Improvements in machinery or apparatus for carding or preparing fibrous materials.

2905. Isaac Atkins, New Basford, Mary-gate, Nottingham, and Marmaduke Miller, Wollaton-street, Nottingham—Improvements in apparatus for measuring and regulating the flow of gas.

2907. William Henry Zahn, New York, U.S.—Improvements in windmills or wind-engines.

2908. James Chesterman, Sheffield—Improved spring, especially applicable to the joints of knives, razors, scissors, and other like articles.

Dated 24th December, 1855.

2911. Sylvain Mathurin Gillet-Oudin, Blois—Improvements in making bread.

2913. William Symons, Tavistock—Improvements in the suspension roasting-jack.

2915. George Lean and Robert Thomson, Glasgow—Improvements in weaving.

2917. Richard Archibald Brooman, 166, Fleet-street—Improvements in treating beetroot and other saccharine vegetable substances, in order to extract alcohol therefrom, and at the same time render or leave the remaining parts of the vegetable fit food for cattle.

Dated 26th December, 1855.

2919. Alexander Tolhausen, 7, Duke-street, Adelphi—Improvements in double-acting pumps. (A communication.)

2921. Franck Clarke Hills, Chemical Works, Deptford—Improvements in economising fuel.

2923. Thomas Duppa Duppa, Longville, Salop—Improvements in generating and heating steam. (A communication.)

2925. Charles May and Edward Alfred Cowper, Great George-street, Westminster—Improvements in combing wool and other fibrous substances, and in machinery for that purpose.

Dated 27th December, 1855.

2927. Edward Alfred Cowper, Great George-street, Westminster—Improvements in combing wool and other fibrous substances, and in machinery for that purpose.

2929. Nicholas Douglass, St. George's-in-the-Fields—Improvements in the construction of lighthouses, beacons, piers, and other similar erections.

2931. James Edgar Cook, Greenock—Improved composition for preserving exposed snrfaces, or surfaces liable to deterioration and decay.

Dated 28th December, 1855.

2933. Jean Jules Robert, 18, Portugal-street, Lincoln's-inn-fields—The fabrication of torrified beetroot to supersede chicory as used in coffee and with a great superiority.

2935. Francis Preston, Manchester—Improvements in the construction of military small-arms.

2937. Paul Marie Salomon, Rue Neuve St. Eustache, Paris.—Improvements in the manufacture of gas from peat and in the coke resulting therefrom, and also in the apparatus connected with that manufacture.

2939. William Rowett, Liverpool—Improved mechanical arrangement for lifting weights and otber useful purposes.

2941. John Pemberton Turner, Birmingham—Improved method of shauking metallic buttons, applicable to the heading of nails and other like purposes. (A communication.)

Dated 29th December, 1855.

2942. Lewis Harrop, Samuel Barlow, and Alexander Boyd, Oldham—Improvements in self-acting mules for spinning and doubling cotton and other fibrous materials.

2943. Herbert Redfern, Shelton—Improvements in skates.

2944. Alfred Ford, Park-lodge, New-road, Hammersmith—Preparing and dissolving in naphtha or oil of turpentine vulcanised india-rubber, for the purpose of waterproofing, and all or any of the other purposes for which the same, not so prepared and dissolved, is now applicable.

2945. John Broadbent and Stanley Peter Youle, Manchester—Improvements in machinery or apparatus for cutting out the gores of umbrellas and parasols, which said improvements are also applicable to cutting out forms or shapes for other purposes.

2946. William Lange, 56, Tachbrook-street—Improvements in biscuit ovens. (A communication.)

2947. William Browu, Glasgow—Improvements in cooking and culinary vessels and utensils, and in the application and conveyance of heat.

2948. George Royds Birch, Paddington—A form and folding desk combined, adapted for the use of schools.

2949. Silvester Lees and Edward Lees, and George Henry Newton, Oldham—Improvements in machinery for spinning and doubling cotton and other fibrous substances.

2950. Thomas Holmes, Hull—Improvemeut in the manufacture of driving straps or bands for machinery.

2951. William Edward Newton, 66, Chancery-lane—An improved process of tauning. (A communicatiou.)

Dated 31st December, 1855.

2953. Charles Cowper, 20, Southampton-buildings, Chancery-lane—Improvements in tho treatment of coal, and in the purification, desiccation, and agglomeration of coal, and in machinery and apparatus for such purposes.

2954. Joseph Salter, Manchester—Improvements in apparatus for promoting the draught in chimneys, and for ventilating apartments.

2955. James Taylor, Britannia Works, Birkenhead—Improvements in apparatus for raising and lowering weights.

2956. Archibald Turner, Leicester—Improvements in the manufacture of looped fabrics.

2957. James Cochran Stevenson and John Williamson, South Shields—Improvements in the manufacture of soda and alkali.

2958. George Hallen Cottam, St. Pancras Iron Works, Old St. Pancras-road—Improvements in applying detonating or exploding signals on the rails of railways.

Dated 1st January, 1856.

1. Henry Truelove, Liverpool—Improvements in gloves.
2. Ferdinand Swift, Brompton-row, Brompton—Improvements in carriage wheels and axles, and in vehicles for common roads.
3. John Calvert, Strand—Improvements in extracting metals from their ores.
4. Alfred Vincent Newton, 66, Chancery-lane—A novel system of propulsion, applicable to land and water. (A commuuication.)
5. William Beckett Johnson, Manchester—Improvements in steam-boilers and engines.
6. Alexander Cochrane, 11, Eaton-terrace, St. John's-wood—Improvements in collecting and distributing water and alluvial deposits contained in sewage and other water.
7. John Thurrell, 32, Castle-street-east, Oxford-street, Elizabeth Mary Muller, 58, Greek-street, Soho, and John Robert Chidley, Gresham-street—Improve-

ments in transmitting fac-simile copies of writings and drawings by means of electric currents.

Dated 2nd January, 1856.

8. Andrew Shanks, 6, Robert-street, Adelphi—Improvements in machinery for cutting screws.
9. William Bullough, Blackburn—Improvements in machinery or apparatus for sizing yarns.
10. Richard Albert Tilghman, Philadelphia — Improvements in the manufacture of iron.
11. George Hamilton, Great Tower-street—Improvements in apparatus for weighing.
12. Harvey Lewis Sellars, M.D., and John Littler Talhott, Cincinnati, U.S.—Improved apparatus for measuring and weighing grain, seeds, and other substances. (A communication.)

Dated 3rd January, 1856.

13. Richard Gill, Grove-terrace, Pomeroy-street, New-cross—Improvements in the arrangement and construction of the fire-flues and passages of steam-boilers, for facilitating and improving the combustion of smoke.
14. Frederick Haines, Lime-street, City—The deadening of the sound and the prevention of concussion in connexion with machinery, gun and mortar boats, and general ordnance, and other purposes.
15. Charles Toye, Gloucester-street, Queen-square, Bloomsbury—Improvements in terry fabrics.
16. George Williams, 16, Cannon-street-east—Improvements in the construction of water-closets for ships.
17. Joseph William Schlesinger, Northfleet—Improvements in the mode of using emery, glass, and sand, or other substances, or linen or other material, and in the machinery applicable to the manufacture thereof.
18. William Alfred Distin, 31, Cranbourne-street, Leicester-square—Improvements in pipes for smoking.
19. James Bagster Lyall, Castle Frome, Hereford—Improvements in carriages.
22. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in apparatus or means for facilitating the performance of church and other music on organs, harmoniums, pianos, and other similar keyed musical instruments. (A communication.)
23. Alan Stewart, 25, Regent-street—Improvements in measuring the human figure, and in fitting garments thereto.
24. John Henry Johnson, 47, Lincoln's-inn-fields — Improvements in breech-loading fire-arms. (A communication.)
25. Colin Mather, Salford Iron Works, Manchester, and Charles Millward, Salford—Improvements in steam and vacuum gauges.
26. James Frederick Lackersteen, 7, Young-street, Kensington-square—Improvements in the prevention of collisions on railways.
27. John Fowler, jun., Bristol—Improvements in machinery for giving motion to ploughs and other implements used for cultivating land.
28. Charles Marsden, Kingsland-road—Improvements in the ventilation of sewers, tunnels, mines, and other confined places.

Dated 4th January, 1856.

29. Henry Bernoulli Barlow, Manchester—Improvements in machinery for carding cotton and other fibrous substances. (A communication.)
30. Henry Bach, Sheffield—Improvements in the application of glass to decorative purposes.
31. Charles Hart, Iron Works, Wantage—Improvements in portable steam-engines, and in apparatus connected therewith, for tilling and cultivating land.
32. William Simmons, Oldham—Improved hat body.
33. Robert Gray, 21, Ridley-place, Newcastle-on-Tyne—Improvements in machinery or apparatus for moulding bricks, tiles, and other similar articles.
34. Thomas Hudson, South Shields — Improvement in furnaces.
35. Thomas Key, Bethnal-green—Improved knife cleaning machine.
36. Edward Hammond Bentall, Heybridge — Improved machinery for pulping turnips and other vegetable matters.
37. Joseph Wright, Burton-upon-Trent—Improvements in furnaces and fire-bars.
38. George Tomlinson Bousfield, Sussex-place, Loughborough-road, Brixton — Improvements in the manufacture of jacquard piled, or terry fabrics, when parti-coloured yarns are used. (A communication.)
39. Joseph Betteley, Liverpool—Improvement in the rolling of iron for the making of ships' knees.
40. Francis William Gerish, East-road, City-road—Improvement in the manufacture of cast hinges.
41. Robert Sam North, Derby, and Ralph Peacock, New Holland—Improvements in metallic packings for pistons.
42. William Oliver Johnston, Broomhill Colliery, Acklington, Northumberland—Improvements in apparatus used for giving notice when the water in a steam-boiler is too low.
43. William Saint Thomas Clarke, 29, Charing-cross—Improvements in ventilation.
44. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of iron and steel.

Dated 5th January, 1856.

45. Raymond Kammerer, Ostend, and Charles Brewer, Chelsea—Improvements in electric clocks or time-keepers.
46. James Coxeter, 22, Grafton-street-east—Improvement in an apparatus for generating steam for medical and other purposes.
47. Henry Hindle, Cavendish-street, Ashton-under-Lyne —Improvements in valves or apparatus for regulating the flow of steam and gas.
48. Joseph Corhett, Brierly-hill — Improved method of preserving the tuyeres of blast furnaces.
49. Louis Auguste Thérèse, Paris—Improvements in harness.
50. Conrad Abben Hanson and John Wormald, Belmont, Vauxhall—Improvements in signal and other lamps.

Dated 7th January, 1856.

51. Victor Delperdange, 125, Rue Verte, Schaerheck, Brussels—Improvements in metallic and elastic packing.
52. Charles Jarvis and Thomas Deykin Clare, Birmingham —Improved oven or kiln to he used in the manufacture of coke and pottery, and for heating and drying generally.
53. Samuel Cunliffe Lister and William Tongue, Bradford —Improvements in machinery for combing wool, cotton, and other fibrous materials.
54. Thomas Barter, Hart-street—Improved apparatus for administering vapour and douche baths.
55. Richard Archibald Brooman, 166, Fleet-street—Improvements in machinery for boring and excavating. (A communication.)
56. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of manufacturing rods, shafts, and tubes, of iron and steel. (A communication.)

Dated 8th January, 1856.

58. Matthias Edward Bowra, 63, Basinghall-street—Improvements in the nature and manufacture of water-proof garments and other goods.
60. George Baring Locke, Notting-hill, Kensington — Improvements in signalling from trains whilst in motion.
61. Edwin Thomas Truman, Old Burlington-street—Improvement in artificial palates and teeth.
62. Henry Stuart, Liverpool, and Thomas Pritchard, Runcorn—Improvements in watches and chronometers, which improvements are also applicable to clocks and other time-pieces.
63. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in jacquard machines. (A communication.)
64. Samuel Middleton, St. George's-row, Southwark—Improvement in the leather-covered rollers used in spinning machinery.

Dated 9th January, 1856.

65. John Talhot Pitman, 67, Gracechurch-street—Improved mode of applying diastase and heat to the saccharification of starch. (A communication.)
66. George John Christian Erhard Hald, Manchester—Improvements in the construction of stoves. (A communication.)
67. Frederick Albert Gatty, Accrington — Improvements in the manufacture of lake colours.
68. Victor Jeanne, Adolphe Martin, and Michel Edmond Martin, Paris—Improved grease box for axles, journals, and other rotary parts of machinery.
69. William Barrie, Comm. R.N., Maida-hill, London—Improved reflective leveller. (A communication.)
70. Edward Hallen, Cornwall-road, Lambeth, and William Holland Kingston, Bandon, Cork—Improvements in communicating between the guards and engine-drivers, and between the passengers, guards, and engine-drivers of railway trains.
71. John Ashworth, jun., Turton, Lancaster—Improvements in lap machines or apparatus used in the preparation of cotton and other fihrous substances for spinning.
72. Anker Heegaard, Copenhagen — Improvements in making channels or flues.
73. Lamhert Alexandre, New York—Improvements in propellers for vessels.
74. Charles Mathew Barker, 25, Kennington-lane—Improvement in the pistons of steam-engines.
75. William Watson, Leeds—Improvements in the arrangement of furnaces.
76. Henry Adcock, City-road—Improvement in casting iron and other metals.

Dated 10th January, 1856.

77. Martin Billing and Frederick Augustus Harwood, Birmingham—Improved machinery for the manufacture of paper bags.
78. John Darlington, Albert-street, Newington—Improvements in the manufacture or production of zinc or spelter.
79. John Erskine, Glasgow — The application of a new material or mixture for dressing or sizing textile fabrics or materials.
80. Jane Ann Herbert, 5, Waterden-place, Guildford—Improved method for extracting the dirt, or the gum, or the colouring matter, or the principle from various vegetable or animal substances or materials. (A communication.)

Dated 11th January, 1856.

81. James Fernihough, Dukinfield—Improvements in steam-boilers, and apparatus for consuming smoke.
82. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in cards for jacquard mechanism. (A communication.)
83. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in railway-breaks. (A communication.)
84. Thomas Charles Clarkson, 216, High-street, Wapping—A combination of certain materials for forming and making improvements in ship and other pumps, tubes, and which is also applicable for ship-carriage and other huilding purposes and parts thereof.
85. Alfred Vincent Newton, 66, Chancery-lane—Improved method of curing meats, preserving provisions, and ventilating and cooling buildings, cars, and vessels. (A communication.)
86. William Pole, Storey's-gate, and Frederick William Kitson, Leeds – Improvements in railway-wheels.
88. William Routledge, Salford—Improvements in cocks or valves for regulating the flow and pressure of steam, water, or other fluids.

Dated 12th January, 1856.

89. Alexander Bain, Westbourne-park-road, Paddington —Improvements in the construction of inkstands.
90. Emile Constantin Fritz Sautelet, Paris—Improved process of tanning.
91. Charles François Leopold Oudry, 89, Rue de l'Echiquier, Paris—Improvements in the preservation of metals and other solid substances.
92. Harry Emanuel, Hanover-square—Improvements in the manufacture of spoons, forks, and other similar articles in metal. (A communication.)
93. William Owen, Rotherham—Improvements in the manufacture of railway wheels and tyres.
94. Richard Kemsley Day. Plaistow—Improvements in the manufacture of fuel.
95. Alexander Bankier Freeland, Manchester—Improvements in the preparation of flour for the purposes of its hetter preservation and carriage, and in the machinery or apparatus employed therein.

Dated 14th January, 1856.

96. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improvements in balanced slide-valves for steam-engines. (A communication.)
97. William Collett Homersham, Caroline-villas, Kentish-town—Improvements in machinery for the preparation of hemp, flax, and other fibrous materials.
98. Adolph Pollak, Vienna—A new fusee or cigar light.
99. Adolf Pollak, Vienna—Treating waste oily matters to ohtain a product applicahle to the manufacture of soap and other useful purposes in the arts.
100. Edward Hammond Bentall, Heyhridge—Improvement in the construction of machinery for cutting and pulping turnips and other vegetahle matters.
101. Nathaniel Shattswell Dodge, 44, St. Paul's Church-yard—Improvements in the preparation or manufacture of leather cloth.
102. Austen Chambers, Canterbury, and William Harrison Champion, Lynsted, Kent –Improved mode of working railway-hreaks.
103. John Gottlieb Ulrich, 63, Mark-lane—Improvements in chronometers and other time-keepers.
104. Anne Emilie Malteste, Paris—Improvements in shirts.
105. Abraham Gerard Brade, Paris—Improvements in recovering the wool from fabrics in which the same exists, together with silk or vegetable textile fibres.
106. William Owen, Rotherham—Improvements in stoves and fire-places.

Dated 15th January, 1856.

107. Pierre Theophile Auguste Nicoulland, 39, Rue de l'Echiquier, Paris—Improvements in steam-hoiler furnaces. (A communication.)
108. Joseph Hostage, Thomas Ives Brayne Hostage, and John Tatlock, Chester—Improvements in railway-chairs.
109. Samuel Sheppard, Birmingham—Improved tap or stop-cock.
110. Thomas Hill Bakewell, Welford-road, Leicester—Improvements in ventilating, warming, and cooling rooms and other places.

Dated 16th January, 1856.

112. Henry McEvoy, Hall-street Works, Birmingham—Improvements in locks, latches, and staples.
113. Henry Law, 15, Essex-street, Strand—Improvements in heaving-up slips for the repair or construction of ships or other vessels, and for a continuous-action purchase for the same, which is also applicahle to other purposes.
114. William Prangley, Salisbury—A novel instrument for exercising the third finger, and thereby facilitating the playing upon musical instruments.
115. Vincent Scully and Bennett Johns Heywood, Dublin —Improvements in the construction of inkstands, applicable in part to other vessels for the reception of fluids.
116. John Abraham, Birmingham—Improved machinery for the manufacture of percussion-caps, and for cutting out and raising articles in metal generally.

117. John Hamilton, jun., Liverpool—Improvements in the posts or uprights employed in constructing electric telegraphs.
118. Johnson Thompson, Sunderland—Improvements in ships' keelsons.
119. John Hamilton, jun., Liverpool—Improvements in constructing the permanent ways of railways.
120. John Fowler, jun., Bristol—Improvements in machinery for ploughing land.
121. David Dring, 149, Great Dover-road—Improvements in machinery for cutting wood-pegs. (A communication.)

Dated 17th January, 1856.

123. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improved apparatus for the prevention of accidents or collisions on railways. (A communication.)
124. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improved gas-meter. (A communication.)
125. Philipp Rechten, Bremen—The taking of whales and other cetaceous fish by means of a harpoon constructed on entire new principles.
127. James Jackson, Manchester—Improved apparatus for retaining and releasing cords of "Venetian blinds," or cords, bands, or chains employed for other purposes.
128. Oliver Philcox, 30, Willes-road, Kentish-town—Increasing the effect and the facility in fingering the pianoforte, organ, or other musical instrument having a keyboard.
129. William Chapman, Sunderland—Improvement in propelling vessels.
130. Joseph Jesse Comstock, New York—Improvements in generating steam. (A communication.)

Dated 18th January, 1856.

133. Giuseppe Antonio Tremeschini, Vicence (Lombardo Venetian) — Improvements in electro-telegraphic communications.
134. Joseph Moseley, Well-walk, Hampstead—The transport of all goods, merchandise, and valuable commodities whatsoever.
135. Miguel de Bergue, Barcelona—Improvements in the permanent way of railways.
136. Joseph Schloss, Wellington-chambers, Cannon-street-west—A piston-bolt, or certain improvements in fastening travelling-bags, portmonnaies, cigar cases, writing-desks, drawers, doors, and similar objects where locks, bolts, or clasps are employed.
137. William Marshall, Smethwick — Improvements in rolling iron for the manufacture of gun barrels and tubes, and for other like purposes.
138. Henry Griffith Rule, Manchester—Improvements in machinery or apparatus for measuring water or other fluids.
139. David Shaw, Gee Cross, Chester—Improvements in looms for weaving.
140. Edward Myers, Rotherham—Improvements in buffers and other springs for railway and other carriages.
141. Nathaniel Shattswell Dodge, St. Paul's Churchyard—Improvements in treating vulcanized india-rubber or gutta-percha. (A communication.)
142. François Jules Manceaux, Paris—Improvements in fire-arms.
143. Jonathan Holden, Halifax—Improvements in machinery for cutting or carving and figuring wood.
144. Charles Weightman Harrison, Woolwich—Improvements in transmitting communications, and in the apparatus employed therein.
145. Joseph Marzolo, Padua — "A reproductive organ," printing with known notes any musical fancies, and equally applicable to pianofortes, melodiums, harmoniums, accordeons, and generally to all keyed musical instruments.
146. James Buckley, Oldham—Improvements in looms for weaving.

Dated 19th January, 1856.

147. Alfred Heaven and William Booth, Manchester—Improvements in machinery for embroidering fabrics.
148. Alfred Dawson, 14 Barnes-place, Mile-end-road—An apparatus for converting small coals, or coal-dust, or small coals and coke, or coal-dust and coke, with the admixture of water or other materials, into solid blocks of fuel, parts of which apparatus can be used and are suited for other purposes.
149. Edward Pickering, Chatham-place, Blackfriars—Improvements in the permanent way of railways.
150. John Armour, Kirkton Bleach Works, Renfrew—Improvements in bleaching, washing, or cleansing textile fabrics and materials.
151. Isaac Barnes, Birmingham—Improvements in carriage lamps.
152. Thomas Horsfall, Deptford, and William Turnbull, Rotherhithe—Improved machinery for breaking and preparing hemp, flax, and other similar vegetable fibres.
153. Frederick Ayckbourn, 10, Princes-street, Stamford-street—Improvements in the cleaning of knives and forks.
154. Herman John Van den Hout and Ebenezer Brown, Kentish-town—Improvements in the preparation of pulp for the manufacture of paper, millboard, and other like purposes.
155. Charles Robertson, 68, Mark-lane—Improvements in mariner's compasses.

Dated 21st January, 1856.

156. Rev. Samuel Fenton, Saint Mary's, Wavertree, Lancaster—Improvements in locks and fastenings.
158. John Gedge, 4 Wellington-street-south, Strand—Improvements in the manufacture of boots or shoes. (A communication.)
159. James Pockson, Penton-street, Walworth—Improvements in the construction of roofing and other tiles.

Dated 22nd January, 1856.

162. Pierre Lewis Tieffé-Lacroix, Metz—Improvements in machinery for cutting files.
163. Jean Baptiste Pierre Alfred Thierry, jun., Jean Louis Richard, Paris, and Baron Henry de Martiny, Versailles—Improvements in preventing smoke by means of a fumivore hygienic apparatus.
164. John Gedge, 4, Wellington-street-south, Strand—Improvements in wrought-iron wheels. (A communication.)
165. John Gedge, 4, Wellington-street south, Strand—Improvements in bending, edging, and soldering tin. (A communication.)
166. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in machinery or apparatus for manufacturing nails. (A communication.)
167. Alexander Robertson, Upper Holloway—A new manufacture of cases or canisters for dry goods, edibles, and such like commodities.
168. Thomas Hitt, Tavistock-street—Certain arrangements of machinery for converting reciprocating into rotary motion.
169. Edward Lawson, Leeds, and George Jennings, Hunslet —Improvements in reeling-machines for winding flax, cotton, and other yarns.
171. Joseph Francis, New York—Improvements in the manufacture of metallic boats.
172. John Beech and Edward Jeffreys, Shrewsbury—Improvements in the means of supporting the rails of railways.
173. Henry Elliott Hoole, Green Lane Works, Sheffield—Improvements in stove grates.

Dated 23rd January, 1856.

174. John Onions, Wellington-place, Blackfriars-road, Southwark—Improvements in the manufacture of iron.
175. George Holcroft, Manchester, and James Peacock, Salford - Improvements in casings for fencing horizontal shafts.
176. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improved manufacture of yarn from wool or other felting material. (A communication.)
177. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improved lock joint for the rails of railways. (A communication.)
179. Edward Lloyd, Dee Valley, near Corwen, Merionethshire—Improvements in valves, and in the valve-gear of locomotive and other steam-engines.
180. Johannis Joachim Mathias Meyer, Bartlett's buildings —Improved mode of manufacturing bank notes, cheques, and other like documents.
182. Archibald Turner, Leicester—Improvements in the manufacture of elastic fabrics.
183. Isaac Barnes, Birmingham—Improvements in the manufacture of knobs and furniture for doors, drawers, and other similar purposes, parts of which improvements are also applicable to the manufacture of cornice poles and other like articles.
184. James Newman, Birmingham, and William Whittle, Smethwick—Improvements in the manufacture of shafting for mill and engine purposes, which improvements are also applicable to the manufacture of shafts, poles, beams, masts, spars, and other similar articles, in which great strength or lightness, or both these qualities combined, may be requisite.
185. Stephen Norris, New Peter-street, Westminster—Improvements in the manufacture of boots and shoes and other coverings for the human feet.

Dated 24th January, 1856.

186. Louis Antoine Romain Richoux, Paris—Improvements in clock-works.
187. Pierre Samain, Meusnes (Loire-et-Cher), France—Improved levelling instrument.
188. John Solomons and Edwin Lander, Birmingham—Improved cigar-holder.
189. Charles Rothwell, Stalybridge—Improvements in self-acting mules.
190. John Strafford, Stratford—Improvements in portable signal-lamps for railway, marine, and other purposes.
191. John and George Gimson, Stnley Bridge—Improved apparatus applicable to steam-pipes used for the purposes of heating and drying, which said apparatus may also be used for other similar purposes where steam is employed.
192. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in air-beds, mattresses, and cushions. (A communication.)
193. George Brooks Pettit and Henry Fly Smith, Oxford-street—Improvements in gas-heating apparatus.
194. David Fisher, 12, Ranelagh-road, Thames-bank—Improvements in machinery for pressing, cutting, drying, and opening tobacco.

Dated 25th January, 1856.

196. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improved machine for boring and other cutting operations in stone and other mineral substances of similar character. (A communication.)
198. Andrew Shanks, 6, Robert-street, Adelphi, and Francis Herbert Wenham, Effra Vale Lodge, Brixton—Improvements in water-gauges.
200. John Kershaw, Stockport—Improvements in apparatus for preventing the explosion of steam boilers.
202. Joseph Peak, Manchester—Improvements in machinery or apparatus for pointing and turning bolt-heads, facing nuts, centreing, drilling, and similar purposes.
204. Alexander Dalgety, 76, Florence-road, Deptford—Improvements in vices, or gripping or holding apparatus.
206. William Owen, Red Lion-square—Improvement in pianofortes.

Dated 26th January, 1856.

208. George Henry Ingall, Old Broad-street, and George Oscar Shaw Browne, Glass-house-street, Nottingham—Improved method of railway signalling.
210. George Napier, Bath-street, Glasgow—Improvements in the construction and arrangement of the flues, air passages, and other parts of furnaces, and also in controlling the passage of smoke, and in heating and regulating the supply of air to facilitate combustion.
212. Edward Vincent Gardner, 24, Norfolk-street, Middlesex Hospital—Improvements in beating, drying, desiccating, and evaporating.
214. Jean Louis Ambroise Huillard, Paris—Improvements in the processes of singeing and dressing textile fabrics, and in apparatus for the same.
216. Samuel Statham, Islington—Improvements in electric telegraph conductors.
218. William Beasley, Smethwick—Improvements in machinery or apparatus to be employed in rifling the barrels of fire-arms and ordnance.

Dated 28th January, 1856.

222. John Wormald, Manchester—Improvements in machinery or apparatus for folding, "fenting," and making up goods or fabrics.
224. Augustin Magloire Jullienne, Herblay (Seine-et-Oise), France — Improvements in brakes for railway trains.
226. Pierre Samain, Meusnes (Loire-et-Cher), France—Improvements in tables, stools, and other pieces of household furniture.
228. Robert Barrow, 32, Garford-street, Poplar—An equilibrium slide-valve for steam-engines.
230. William Asbury, Birmingham—Improved tap or stop cock.
232. John Whitehead, Leeds—Improved machinery for fulling cloth. (A communication.)

Dated 29th January. 1856.

234. George Darlington, Minera, near Wrexham — Producing oxide of zinc from its ores.
236. Daniel Foxwell, Manchester—Improvements in sewing machines.
238. Robert Thatcher, Oldham—Improvements in preparing for doubling or spinning cotton or other fibrous substances.
240. Owen Murrell, Bethnal Green-road—Improvements in swing looking glasses.
242 Henry Chance, Birmingham—Improvement in the manufacture of moulded articles when using vitreous materials.
244. Joseph Fowell Walton, Sarratt-hall, Rickmansworth, and Honore Le François, Lambeth—Improvements in cleaning forks, spoons, stew-pans, and other culinary utensils.
246. Auguste Mathieu Maurice de Bergevin, 27, Rue Labat, Montmartre, Paris — Improvements in preparing coal for burning, and in the furnaces employed in consuming such coal.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

122. Henry R. Worthington, New York, U. S.—A machine for measuring the flow of liquids, called a "fluid metre." 16th January, 1856.
160. John Wordsworth, Robson, Grundy-street, Poplar New Town—Improvements in machinery appertaining to water-closets and pumps.—21st January, 1856.
170. Dundas Smith Porteous, Paisley—A rotary-engine.—22nd January, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.

Jan. 21. 3804. R. Besley and Co., Fann-street, Aldersgate-street. "Composing Stick."

,, 24. 3805. Frederick Smith, Birmingham, "Improved Tap."

,, 29. 3806. Thomas Poole and Alexander Macgillivray, Princes-street, Cavendish-square. "Rotatory Map Stand."

Feb. 1. 3807. Smith, Kemp, and Wright, Birmingham, "Clasp for belts and other articles of dress."

,, 2. 3808. Price's Patent Candle Company, Belmont, Vauxhall, "Lamp for omnibuses and other carriages."

,, 7. 3809. Thomas and Charles Clark, Wolverhampton, "Improved sash frame guide pulley."

Fig. 1.
EXTERIOR ELEVATION, FRONT VIEW

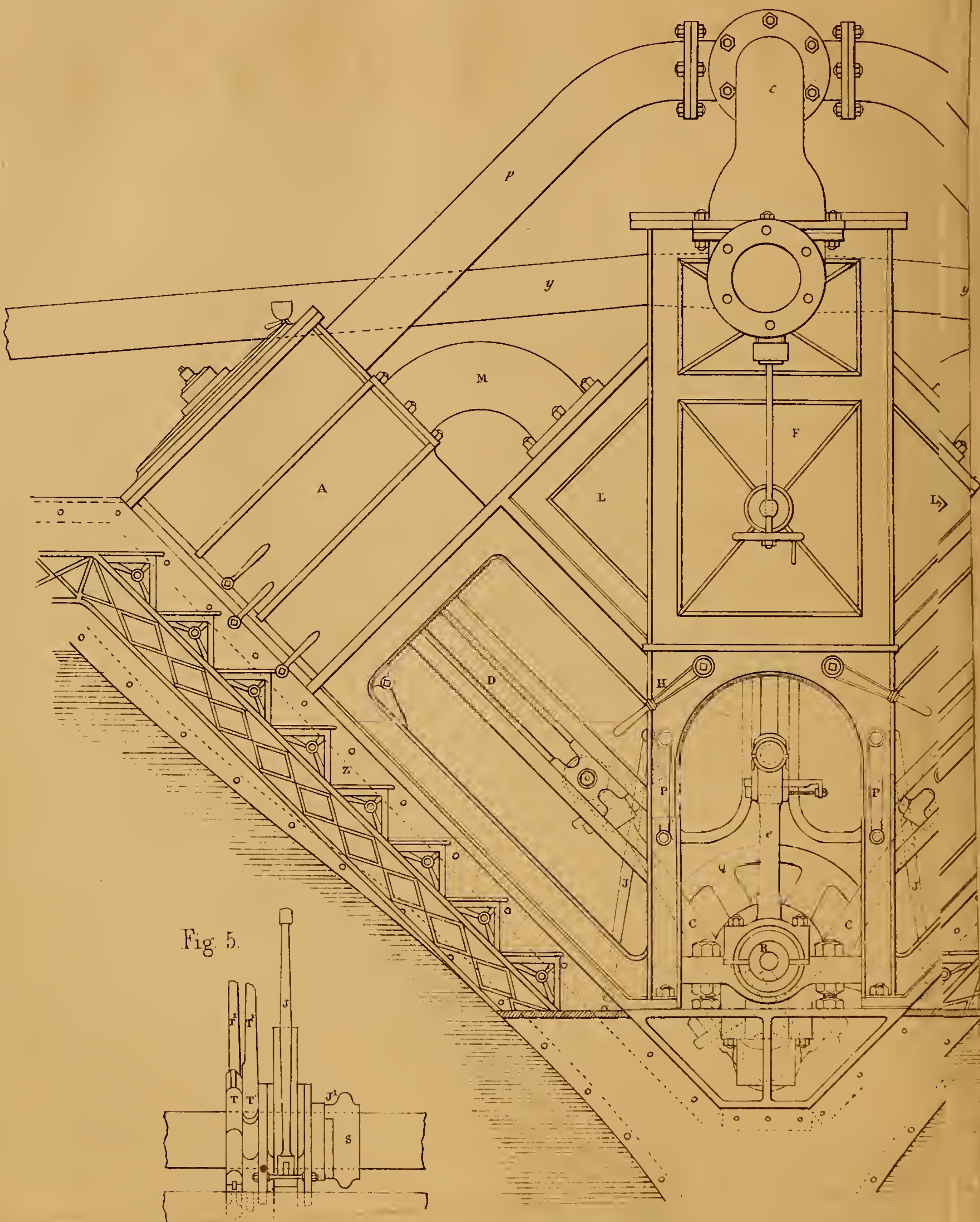


Fig. 5.

THE ARTIZAN.

No. CLIX.—Vol. XIV.—APRIL 1st, 1856.

MARINE ENGINES.

By Mons. Gache, Engineer, Nantes.

We present our subscribers this month with a plate, illustrating the engines patented by M. Gache, of Nantes, and exhibited by him at the Exposition of 1855, in Paris, and which we considered at the time were worthy of special notice.

M. Gache has applied these engines, of various powers, ranging from 25 to 200 H.P., on board of twenty-one vessels, all of which have worked most satisfactorily. He is also fitting several pairs of 60 H.P. for auxiliary screw-ships of 1,200 tons.

The present plate (No. 70) contains literal references, by which the details will be more readily understood. Next month we hope to be able to give a second plate of these engines.

We have been favoured by M. Gache with the following description, which we give as accurately as we can:—

"The first plate shows a pair of expansive and condensing engines, constructed by me. They are of 55 H.P., working at the pressure of two atmospheres, or 2·066 kilo. the square centimetre. The steam-cylinders, A, are upon a vertical plane, but inclined to 45° as to the water-line, so that their piston-rods, D, are perpendicular one to the other.

"The expansion is fixed and determined by receiving slides, which restrain it to $\frac{6}{10}$ the length of stroke.

"The shaft, B, is driven directly by the engines; it has two cranks, *a* and *b*, to give the motion directly also to the piston, *d*, of the air-pump, E, which is vertical, and enclosed in the condenser, F, which is above and between the two steam cylinders, A; this disposition of the condenser binds all the fixed pieces of the apparatus, and gives it much strength. The elevated position of the air-pump diminishes much the length of the waste water pipe, whose pressure acts strongly on the pistons of the air-pumps, generally placed at the bottom of the hold, and avoids the shocks which result from this pressure, especially in engines worked at high speeds.

"The blow-valves, I I, J J, *n* and *o* (Fig. 3), have consecutive motion and uniform lifting. The india-rubber plate, *v*, (Fig. 7), is first lifted up from *x* to *x*, then the blow-valve, *y*, in rolling on the pin, *z*, is carried to the catch-ring, *z*: in this position the opening of the blow-valve is uniform throughout its whole extent;—this permits us to give it very little lifting. These blow-valves act without jerking or noise, even when in a heavy sea; the engines acquire suddenly, and at intervals, a speed of from 90 to 100 revolutions. The blow-valves, I I, are lifted during the upward motion of the air-pump piston, its downward motion closes them by opening the blow-valves, *j j*, which allow the water of the condenser to rise into the hot-water well, *k*, by the chimney, V.

"The blow-valve, N, allows the gas to pass into the air-pump during the downward motion of the piston, which, on re-ascending, forces it out into the hot-water well, *k*, through the blow-valve, *o*. [Here the engraver has made a mistake, by representing, in the condenser under the blow-valve, N, and over the air-pump piston, the condensing water, which is to be found only in the lower part of the condenser, as shown in the sketch (Fig. 3).]

"The piston, *e*, of the feed-pump, C, is furnished with a suction-pipe, *k*, which has a valve worked by the handle, *l*, in order to facilitate the inspection of the blow-valves, when the engines are working.

"The steam slide-valves, placed in the boxes, X (Fig. 2), are worked directly by the side rods, T′, of the eccentrics, T T (Figs. 3, 4, and 5).

"To change the working of the engines we must turn the eccentrics, T T, on the motion-shaft, B, in making use of the mechanism, whose details are to be found in Figs. 2, 3, 4, and 5.

"P P′, two handles, each fixed at one end of the horizontal axis, *q*; the other end of the axis is provided with a little crank, *r*, articulated with a side rod, *s*; the side rod governs the sector, *t*, which acts by friction by means of grooves with which it is provided in order to give it more adhesion to the circumference, equally grooved, of the disc, Q, which is secured upon a bracket, R, moveable on the motion-shaft, B.

"A ring, S, fixed on the shaft has a catch ring which thrusts the eccentrics, keeping them in the proper position to work the engines backwards and forwards. Now, if the disc, Q, be turned right or left by either of the handles, P P′, the bracket, R, and the two eccentrics, T T, of the slide-valves will be displaced, since they are bound together.

"This mechanism has great power: it allows the engineer, in every case, not only to work the slide-valves without assistance, but, moreover, to give the engines many revolutions without the aid of the steam; a manœuvre which presents itself in many cases—viz., when the screw-shaft is to be connected or disconnected.

"The waste water pipe, *y*, distributes the water, and the vapour of the condenser in the two pipes, *y y*′, fixed in the ship's side; when the latter heels to starboard the pipe, *y*, supplies the water, and the pipe, *y*′, the vapour; this pipe, in turn, lets the water pass when the ship heels to larboard.

"The main parts of these engines are of very easy access, and those which require frequent examination may be taken out without removing the parts unconnected with them: thus, the steam pistons may be withdrawn, or their springs tightened, by taking out the bottom of the cylinders, A A; the examination of the blow-valves of the condenser takes place at the hole behind (Fig. 2) that of the slide-valves by lifting up the cover of the box, X; the valves of the feed-pump may also be inspected during the working of the engines by means of the hole above their box.

"This system, which I have patented, and which I employ in sailing and steam vessels, is in use on board twenty-one ships of from 26 to 200 H.P. It allows the engines to be placed abaft, and admits a reduction in the length of the screw-shaft by leaving the greatest part of the hold disposable; this position permits us also to place the chimney before the mizen-mast in such a manner as not to interfere with the working of the sails. It also renders the introduction of watertight bulkheads on board of iron vessels much easier and safer.

"The engines, of 55 H.P., represented by these drawings, having been repeated twelve times and fixed in ships perfectly alike, I have been

V. GACHE'S PATENT ENGINES.

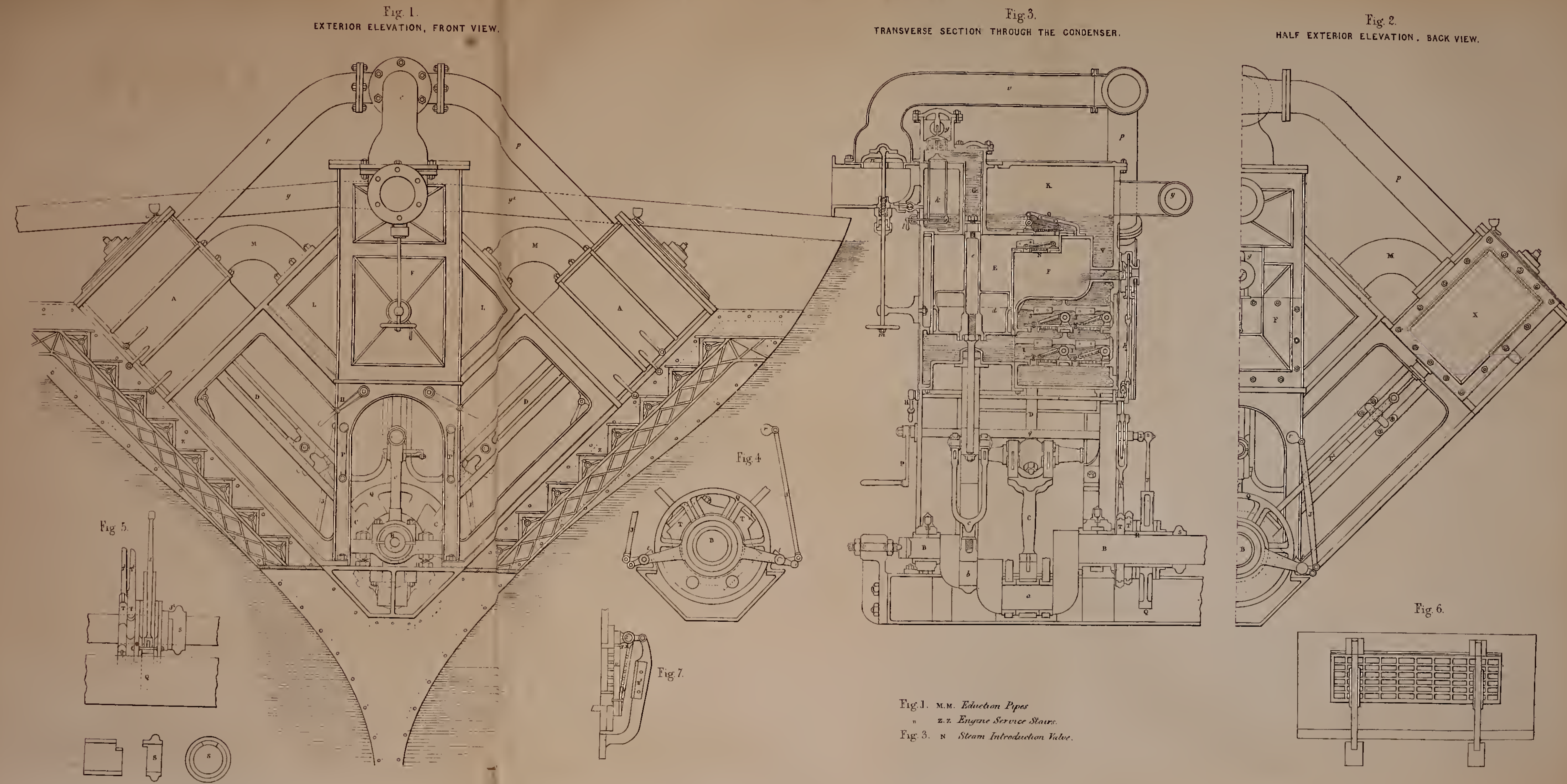


Fig. 1. M.M. *Eduction Pipes*
" Z.Z. *Engine Service Stairs.*
Fig. 3. N *Steam Introduction Valve.*

Wm Smith, C.E. direxit.

enabled to make accurate trials, of which you will find the results in the following table :—

Dimensions of Ship.	French Measurement.	English.
Length, extreme	43 mètres.	141·033 ft.
Breadth, extreme	6·14 mètres.	20·145 ft.
Depth	3·14 mètres.	10·320 ft.
Tonnage, legal, after deducting $\frac{2}{5}$ for the space occupied by the engines	$160\frac{52}{100}$ tons.	152·400 tons.
Displacement when loaded	442·25 tons.	448·630 tons.
Draught of water when laden	3 mètres.	9·840 ft.
Area of immersed section at load draught	16·15 mètres	19·315 sq. yds.
Mean speed	8 nœuds.	9·918 miles.
Engines :—		
Diameter of cylinders	0·64 mètres.	25·052 in.
Length of stroke	0·56 mètres.	22·008 in.
Indicated mean pressure on the pistons, the square centimeter	1·358 kilo.	3·639 lbs.
Revolutions per minute	55.	55.
Diameter of screw	2·50 mètres.	8·202 ft.
Pitch of screw	6 mètres.	19·686 ft.
Number of blades	4.	4.
Fraction of pitch	0·30 mètres.	$\frac{3}{10}$.
Slip of screw	0·25 mètres.	$\frac{25}{100}$.

M. Gache states that he is constructing three pair of engines of 60 H.P. upon the same system, as auxiliary to sailing ships of 1,200 tons, intended for long voyages."

THE LIGHT CAVALRY OF THE ROYAL NAVY.

THE "FLYING FISH" CLASS, OF 350 H.P., CARRYING 6 GUNS.

The attitude of this country at the present moment is one of intense interest. The war was entered into, at least by the governing classes, with great reluctance. It cannot be denied but that our first efforts were not as beseemeth the position of the first of nations, and our national and hereditary pride suffered accordingly. Now, however, that we are fairly alive and thoroughly aroused, we are brought up all standing, just as we are completely *equipped* for the fight, by the Great Bear, who, fearing the attitude and determination of his enemy, is now suing for peace.

Were the feelings of the nation thoroughly canvassed, it would be found that, with a laudable and Christian desire for peace, there is a greater desire for war ; not for its own sake, but that there is a consciousness that with the sword in our hand, the honour of the country is safe, but that in the hands of diplomacy (judging from antecedents) that honour stands a fair chance of being sadly tarnished. There is a common-sense consciousness that Russia has not been sufficiently humbled yet, that if peace is *now* made it will be only a piece of patchwork, which posterity will have sadly to regret. It is generally felt that Russia has only laid aside her cherished projects till a more suitable opportunity occurs.

At the commencement of the war we urged strongly on the Government the necessity of constructing a very small class of vessels. The splendid fleet of high-pressure gun-boats now assembling at Spithead is the answer, for which we feel thankful.

We have already alluded to the reluctance which marked the first steps of the executive. We were anxious to know whether, now that peace is again in the ascendant, our preparations were still progressing with vigour and energy. We are happy to say that they are. We have lately visited some of the chief seats of manufactures, and we have to report that, whether in the workshop of the engineer, the yard of the shipwright, or in the public arsenals and dockyards, all are now anxiously, unceasingly, at work, with the exception of the few hours of the Sabbath. Night and day the same ceaseless toil is going on ; and we can assure our readers that they may rest satisfied that if diplomacy should fail other measures are in active preparation.

To an article in The Artizan of February last,* entitled "Has England maintained its Engineering Supremacy?" was appended tabulated statistics of the proposed strength of the British Navy for the next Baltic campaign. In these tables will be found a new style of vessel. They are six in number. They carry two heavy 68-pounders, are of light draught of water, and, with their great power in proportion to their tonnage, will have a very high speed,—say 13 or 14 knots per hour.

These peculiar vessels will be found, we doubt not, of great value, and we have designated them the "Light Cavalry of the Royal Navy."

The following are a few of the dimensions of this class :—

THE "FLYING FISH."

1*st. Vessels.*

Length between perpendiculars	200 ft.
Length of keel for tonnage	186 ft. $7\frac{1}{2}$ in.
Breadth, extreme	28 ft. 4 in.
Breadth for tonnage	28 ft.
Breadth, moulded	27 ft. 6 in.
Depth in hold	14 ft.
Burthen	860 tons.
Height from deck to deck	6 ft. 9 in.
Height from deck to beam	5 ft. $11\frac{3}{4}$ in.

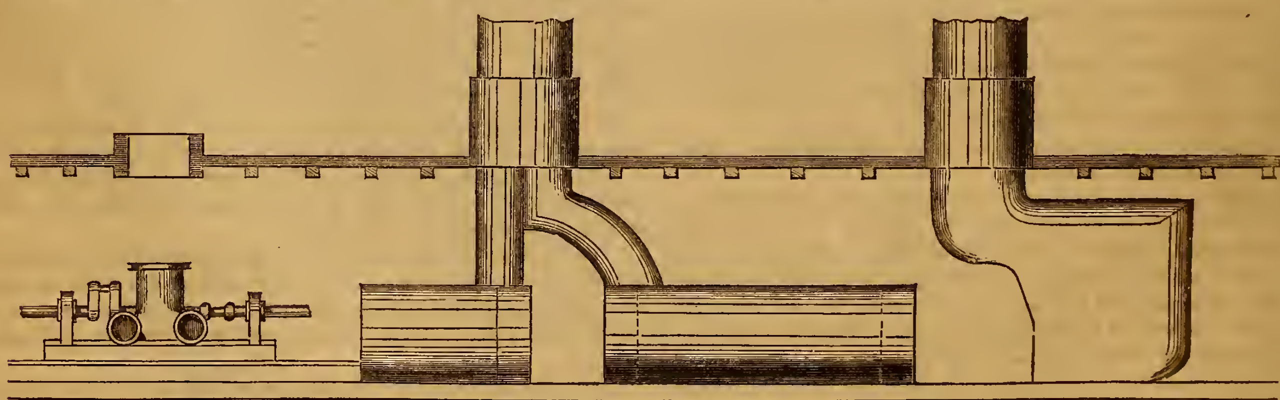
Armament.

2 guns of 95 cwt. 8-in. 68-pounders.
1 gun of 56 cwt. 6-in. 32-pounder.
4 guns of 25 cwt. — 32-pounders.

2*nd. Engines by Maudslay, Sons and Field.*

They are of the class known as the *Princess Royal* engines, namely, horizontal steeple, with two piston-rods to each cylinder.

Nominal H.P.	350
Diameter of cylinder	58 in.
Length of stroke	2 ft. 3 in.



3*rd. Screws.*

Pitch of screw	21 ft. 6 in.
Diameter of screw	11 ft.
Length of screw	3 ft.

4*th. Boilers.*

To get this amount of boiler power into such a small vessel, and to keep that under the water-line, not a little ingenuity has been displayed. The boilers are in six pieces, placed in pairs athwart the ship. Four of the boilers are called the *fighting* boilers, because they are so low as to be under the water-line. They (the low boilers) contain, we think, about two-thirds of the power, and will be ample for speed when manœuvering in action. The two high boilers are only used when full speed is required. We give above a sketch of the arrangements, with a few leading particulars of the boilers.

Number of boilers, 6 pieces (2 high and 4 low).
Number of furnaces, 18 (6 in high and 12 in low).
Diameter of tubes, $2\frac{1}{2}$ in.
Diameter of funnels, 4 ft. 10 in. (2 in number).

* See Artizan, February, 1856, page 31.

THE LATE MR. JAMES CARMICHAEL, ENGINEER.

WARD FOUNDRY, DUNDEE.

We have ever been ready in giving a becoming and graceful tribute of respect to the departed, when, from time to time, we are enabled to present our readers with biographical sketches of eminent mechanicians and engineers, and whilst making such an addition to our scanty mechanical literature, we convey, we hope, to the young aspirant in our honoured and important profession worthy precedents and honourable examples.

We, who now bear the burden and heat of the day, look back with reverential feelings on our *fathers* in the profession. As we see one and another dropping from the busy stage of active, onward life, we feel no ordinary pleasure in recording in our pages our deep sense of their many virtues and excellencies;—to say how much we are indebted to them *personally* and professionally, and also how much the nation is under obligations to these *masters* in their several professions.

Those who know anything of the staple trade in the shape of flax factories and other engineering works in the counties of Forfar, Fife, and Aberdeen, will, we are sure, feel that we are only rendering a just tribute of respect to one of the most eminent and practical engineers of the day in which he lived; and who, as inventor of the Fan Blast, will be held in esteem by all who are in any way connected with the innumerable branches of the iron trade where this invaluable machine is used.

James Carmichael's name is intimately associated with the rise and progress of Scotch engineering; and it will be long esteemed by those who had the pleasure of his acquaintance.

James Carmichael was born in Glasgow in the year 1776. His father, George, was the senior partner in the firm of George and James Carmichael (Brothers), carrying on business as merchants in the Trongate, Glasgow.

The subject of our memoir had the misfortune to lose his father at the early age of ten years, when his mother, having disposed of her share of the business, returned with her family of five children to her native place, the village of Pentlands, in Mid-Lothian.

James Carmichael first went to school in Glasgow; and after the return of the family to Pentlands, he was sent to the parish school of Lasswade; a Mr. Hume was then the teacher. This worthy man tried hard to get some *smatter* of Latin into him, as he was wont to express it, without effect, and he was ultimately obliged to give it up. With arithmetic and geometry he was quite at home, and very soon excelled all his schoolfellows in these branches,—thus early manifesting what continued to be the bent of his mind through life.

While attending school at Lasswade he lived with his maternal uncle, Mr. Umpherstone, at Loanhead, who was a country millwright,—and the fourth generation of millwrights of the same family who had carried on business in the same place, and which business is still in the family, now the fifth generation.

After leaving school James Carmichael was bound apprentice to his uncle as a millwright, and served him for the ordinary period,—living, as was the custom then, with the other apprentices in the house of his uncle and master.

It need hardly be remarked that in this retired village in Mid-Lothian, sixty years ago, there were none of the opportunities now so common and so easily obtained by young men, in the shape of libraries; and, in fact, there were few books on the subject of mechanics or millwork at that time in existence.

His uncle seems to have been a person of more than ordinary intelligence, and exceedingly anxious to procure all the information possible connected with his profession. During the currency of James's apprenticeship, "Hall's Encyclopædia" was published in numbers, for which his uncle was a subscriber.

The contents of this valuable work were eagerly read and commented on while sitting around the fireside after the labours of the day, the master sitting with his apprentices, and taking the lead in the conversation.

He was wont to tell that it was from this book that he first learned that bevel wheels could be made at any other angle than 45°.

That the country millwright's fireside was a good, nay, a very superior, training school, was manifest from the fact, that many of his apprentices rose to considerable eminence in their profession,—some of them continuing in close intimacy with the subject of our memoir to the close of their career. Of one of them, who emigrated to America, he wrote a lament, one verse of which has been preserved, running thus—

> "Lament with me my brithers dear,
> Who love to talk of bevel gear,—
> The various shapes that cogs do wear,
> And sic like matters.
> Of sections of the cone and sphere,
> And farmer's happers."

He always spoke in the most reverential manner of the master, whose position seems to have been more like what we conceive of the patriarchal, than any relation we now have as master and servant in the present day.

During his apprenticeship he invented a traversing motion for guiding the threads on the bobbin of the spinning-wheel, at that time used for spinning flax, which motion, being a saving of time to the spinner, as well as saving wastes by building the yarn on the bobbin more equally, was a local wonder; and a wheel with "the rock and the tow," was always kept to show to visitors.

At the expiration of his apprenticeship he went to Glasgow, and entered into the service of Messrs. Thomson and Buchanan, cotton spinners, Adelphi Works. While in their employment he assisted Mr. Buchanan in getting up the Tables of his "Treatise on Millwork," which treatise still continues to be a standard work on this important subject. Some of the Tables for calculating wheels were got up by Carmichael *

He often spoke of the difficulties which had to be contended with at that time, there being no data for calculating the strength of materials or the proportional parts of machinery. The data got up by Buchanan were all founded upon examples of wheels and shafts at work in various parts of the country.

Mr. Carmichael was always very careful to note the sections of broken machinery, and to ascertain the amount of strain sustained—as far as could be ascertained—to guide him in his future practice.

The large quantities of inferior cast-iron thrown into the market during the latter years of his professional career sadly baffled his earlier calculations and experience.

His brother Charles (who also served his time at Loanhead) came to Dundee in the year 1805, and commenced business as a millwright, in company with a Mr. Taylor, under the firm of Taylor and Co. The contract of copartnery was for five years ; at the termination of that period Charles requested his brother James to come from Glasgow and join him. To this he at once agreed, and having disposed of a small property which he had inherited in the neighbourhood of Glasgow to Mr. Thomson, his employer, he came to Dundee in the year 1810.

Their business at first was confined to millwright work and gearing, but the spinning of flax by machinery in Dundee receiving at that time a great impetus, in consequence of the large orders for Government during the height of the great French war, soon induced them to commence making steam-engines.

As makers of stationary engines, the firm of James and Charles

* See "Brunton's Compendium of Mechanics," page 74.

Carmichael were known for the long period of between thirty and forty years, not only in and around Dundee, but in all the towns and villages on the east coast of Scotland, where flax is the staple manufacture. In 1821 they fitted the first twin steamboat for the ferry across the Tay, at Dundee; this vessel answered so well that another, of similar construction, was made, and put on the passage in 1823. An account of this ferry, with descriptions of the machinery, were published in the "Edinburgh Philosophical Journal" by Capt. Basil Hall, R.N., from which the following is extracted:—

"In the year 1815 there were twenty-five boats, or pinnaces, as they were called, on this passage, manned by upwards of a hundred men and boys. There were no regular hours of sailing, and passengers on reaching the landing-place had either to hire a boat at a great expense, or to wait till a sufficient number of persons had assembled to make up the fare; accommodation for the transport of carts, carriages, &c., there was none. In the year previous to the first steamboat being put on the passage the number of passengers was about 70,000: in 1824, only three years after, the numbers were as follows—passengers, 100,536; carriages, 130; gigs, 474; cattle, 6,627; sheep, 15,449; horses, 477; loaded carts, 2,564."

Appended to the account in the "Edinburgh Journal" is a sketch of the machinery of the twin boats, and a description of that part of it invented by James Carmichael for the purpose of regulating the motion of the engines upon deck; by the simple movement of a small handle, or index, placed on a table upon the deck, in view and in hearing of the steersman and of the master of the vessel, every movement which the engine is capable of giving to the paddle-wheel may at once be commanded. The vessel may be moved ahead or astern, may be eased or entirely stopped at any given moment, by merely turning the handle to the places denoted by the gradations of a dial-plate. No skill is required for this purpose, so that the master himself, or any sailor under his directions, can perform the office as well as the ablest engineer. Thus the confusion which frequently arises at night in calling out to the engineer below is avoided, and any ambiguity arising from the word of command being transmitted through several persons entirely prevented.

The history of this reversing gear is a curious episode in the history of the improved engine, invented as it (the reversing gear) was and applied so early as 1821, and fitted, with complete success, on board the twin steamer on the Tay ferry.

Nevertheless, in consequence of the quiet and unobtrusive character of its inventor, coupled with a resolution on which he had always acted never to patent any of his inventions, it never became known or appreciated. Not only then but at the present day the general public in the engineering world are pleased to associate with the name of George Stephenson the discovery of the only really efficient reversing gear in the link motion.

We can recollect the introduction of the link motion in a marine engine by Messrs. Rennie, of London, about the year 1846 or 1847; it was then a great novelty, and a decided improvement. But James Carmichael had solved this problem by an apparatus equally efficient and more simple on board a steam-vessel twenty-five years earlier. This apparatus is fully illustrated and described by his son, Charles, in the pages of a late contemporary.*

We come now to Mr. Carmichael's *chef d'œuvre*—namely, the invention and application of the *fan blast* in the iron manufactures. This is a noble legacy to practical science, and it is doubly enhanced when we reflect that it was given to the public, free and unshackled by any patent right.

* "The Practical Mechanics' Magazine," 1843, p. 262.

In the spring of 1828 Messrs. J. and C. Carmichael set about making experiments* on the model of an apparatus on the principle of the winnowing machine, for blowing a cupola for melting cast-iron. The experiments were varied in every possible way, and the results were so satisfactory that it was resolved to adopt it in the foundry. Owing to various causes, it was the month of May, 1829, before the machine was set to work, when it exceeded the most sanguine expectations. It was soon after applied by them to blow their smiths' forges, where it was found to be still more useful.

The fan-blowing machine speedily came into general use, and although it might have been made a profitable patent, the Carmichaels freely gave the use of it to the trade, and were ever ready to show it at work and give all information on the subject. This liberality was appreciated, for early in 1841 a public subscription was got up and a service of plate presented to each of the brothers, valued at £200. The inscription, as recorded on the plate given to Mr. James, is as follows:—

"Presented to James Carmichael, Esq., Engineer, Dundee, by a few friends in the iron trade, in testimony of their deep sense of the liberal manner in which he and his brother have permitted the unrestricted use of their valuable invention of the Fan Blowing Machines.

"Glasgow, April, 1841."

At a very early date he saw in the distance to what importance steam navigation would attain; and he had a canal constructed in the Ward Foundry Yard, where he made and recorded a mass of valuable data on this all-important subject. His notes are still very valuable and curious as proving the peculiar bent of his original mind.

At a time when *tools* were less numerous and efficient in the iron trade than they now are, he invented a very admirable combined planing, shaping, and boring machine; its movements are apparently complex, but, when thoroughly understood, are really very simple. It has the advantage over every other machine of which we know anything—a continued cut both in going and returning (when planing). Several of these machines have been sent abroad, also to the steam factories of Woolwich and Portsmouth, where they are highly prized. This machine is also fully described and illustrated in one of our contemporaries.†

James Carmichael's health was never very robust, but his abstemiousness and placidity of mind, probably, had a great effect in lengthening his life. He had for several years retired from active duty, but still continued to take an interest in scientific subjects, and to spend a few hours occasionally in his workshop, which he had fitted up in his house. His last job which he had in hand was grinding a specula for a reflecting telescope.

Astronomy was always a favourite subject with him, and he took a great interest in all the discoveries made in that science.

The law of his mind was *concentrativeness:* he could not take a part in mixed company where various topics were discussed, but generally sat silent. With one or two he discoursed eloquently, keeping the same subject and discussing it thoroughly.

In all he said there was a high-toned integrity and rigid regard to truth, without exaggeration, such as is seldom to be met with; it seemed to be almost a mathematical precision, attained by long practice. By those who were in his employment, scattered as they now are over many lands, there will be but one feeling entertained,—of affection and love to the upright man from whose lips proceeded only kind words. Mr. Carmichael died August 13th, 1853.

* See "Transactions of the Society of Arts" for 1829.

† See "Practical Mechanics' Magazine," 1842-43, page 26; also Rennie's work on Tools.

THE CAUSES OF EXPLOSIONS OF STEAM BOILERS.

By Mr. William Kemble Hall, of the United States of America.

Abstract of paper read at the Institution of Civil Engineers, March 4, 1856.

Robert Stephenson, Esq., M.P., President, in the Chair.

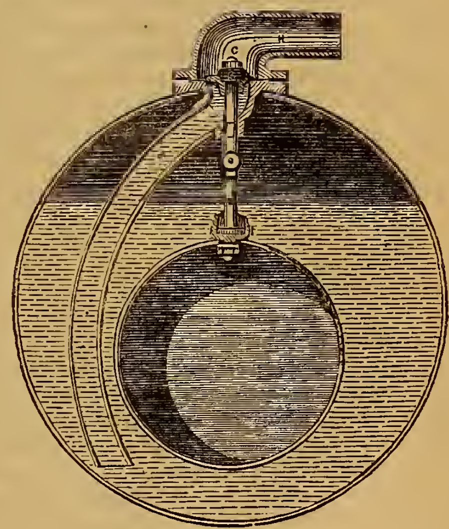
The different theories advanced to explain the action resulting in explosion were examined and illustrated by the ordinary attendant facts. Inherent defects in design and material were sufficiently provided for by the preliminary testing and the ordinary safety-valve, and the deterioration by use could be guarded against by periodical examination. If the pressure of the steam was allowed gradually to increase until it exceeded the strength of the boiler, the danger would be betrayed by some one of the numerous rivets and seams of its structure, as there was always some single point which would first give way. In the boiler which exploded on the 18th of August, at the Hartford Steel Works

Sheffield, the steam was at its usual working pressure of 40 lbs. per square inch, when a rupture took place in the side of the boiler, from which the steam issued with a furious hissing sound, warning the attendants of their danger and enabling them to escape. The side stays were defective and had failed. It was reasonable, then, to suppose, that the tearing of the boiler into several pieces, which generally accompanied explosions, was caused by a sudden exertion of power; and electricity had been suggested as an agent. But although electrical phenomena might be exhibited by the expansion of a jet of steam, it could not be supposed that a boiler, with its many direct and metallic connexions with the earth, could be converted into a reservoir of electricity. If any were generated it would be instantly conducted away. It had been supposed that the plates exposed to the action of the fire by the falling of the water had become overheated and decomposed the steam, the oxygen of which had combined with the iron, and the hydrogen formed a gas, that had caused the explosion. But hydrogen would not explode unless largely mixed with atmospheric air, which could not enter the boiler except in minute quantities, forced through the feed-pump, in combination with water; and although there was evidence of the absorption of oxygen in the rusting of the stays and of the interior surface of old boilers, it was too insufficient in extent to warrant the deduction that there had been an appreciable change in the chemical composition of the steam. It might be possible to produce an external explosion, but not an internal one.

In the explosion at the Consett Iron Works, Gateshead, early in November, it was in evidence that the boiler had been blown out a short time previous, and the valve not closed. The plates had been heated red-hot, and it was supposed that the attendant, who was killed, had discovered the deficiency of water, and had just opened the feed-valve at the instant when the explosion occurred. Now, heat did not lessen the strength of iron up to the temperature of 550°, and had it exceeded that point in this case, and thus weakened the boiler, the result would merely have been a collapse of the flue. When heat was applied to steam, the increase of its pressure was governed by the same law that applied to air and all other elastic gases;—an addition of 480° only doubling its pressure. Experiments had conclusively proved the possibility of heating steam in contact with water without also increasing the temperature of the bulk of the water, the upper stratum of which alone became heated by the contact. If, therefore, it was supposed, for example, that the steam had been heated to 435° Fahrenheit, and water suddenly injected into it, the pressure would have been instantly raised to that due to the presence of the water,—determined by the experiments of Arago and Dulong to be 360 lbs. per square inch at that temperature. Or, to use another illustration, while 1,000° of heat applied to steam would but increase its pressure or volume about three-fold, the same amount would multiply that of water 1,700 times. This vast increase would certainly be modified by the latent heat absorbed by the water in its conversion into steam, but served to indicate a sudden and local generation of excessive pressure, which might result in explosion.

The surcharged steam might be supplied with water without the agency of the feed-pump. At the explosion which occurred at Chiswick, July 16th, when the safety-valve was in good order, and loaded to the average working pressure of 20 lbs. to the square inch, the boiler had been idle during the dinner hour, and the explosion occured as the engineman was in the act of opening the stop-valve preparatory to starting the engine. The water had probably been low, and the sudden flow of steam into the pipes partially relieved the water of pressure, and it was thrown by the agitation into intimate contact with the super-heated steam, and over the hot-plates, and suddenly converted into vapour of too high a tension for the strength of the boiler. It was a well-known fact to those conversant with the practical management of steam boilers, that the water stood higher when the engine was in operation than when it was idle, and that it might be further raised by opening the safety-valve. This effect was more apparent with a contracted water surface and comparatively small steam room. An explosion which took place at the Tower Mills, Sheffield, August 11th, was an illustration. The surviving attendants positively affirmed, that observations of the water-gauges a few minutes previous to the accident showed sufficient water; but an engineer, deputed by the coroner for the purpose, examined the boiler, and testified that it had been overheated, and that such indication was wrong, or had been misunderstood. The boiler exploded immediately after the attendant had made some preparation necessary for opening the safety-valve, and probably at the instant he had opened it. The boilers that exploded at the Walker Iron Works, at Newcastle, October 8th, and at the Kebblesworth Colliery, September 19th, were each provided with a float and two safety-valves. In both instances there was reason to believe that the water had been forced through the connecting feed-pipe, from the boiler that exploded, into the adjoining one, and that in the latter instance the attendant had observed the danger, and was engaged in opening the safety-valve.

Experience had proved that the fusible metal plug, enjoined by law in France, became encrusted by scale, and otherwise rendered inoperative by use, and did not answer the purpose for which it was intended. The softer portions of a compound metal were forced out by the pressure to which it was subjected, and the remainder becoming oxidised, did not fuse at the temperature intended. It, moreover, acted merely as a warning, and did not serve to obviate the impending catastrophe.



All the contrivances hitherto adopted for the purpose of providing against explosions were designed to supply water when that in the boiler had fallen to too low a level, or to open the safety-valve by the pressure of steam, independent of other circumstances. As had been illustrated by the examples alluded to, either of these plans would induce, in many instances, the very accident designed to be avoided. For there seemed every reason to believe that the great majority of explosions were occasioned by the negligence of the attendant in permitting the level of the water to fall below the flues, exposing the plates to a high temperature, and surcharging the steam with caloric, far exceeding that due to its pressure. In injecting an additional supply of water into the boiler when in this dangerous condition, it was thrown over the heated plates, and into the super-heated steam, and suddenly converted into steam of too high a tension for the boiler; and so instantaneously, moreover, that it operated with all the momentum of a blow. And as the water necessary to produce this disastrous result might be supplied from that already in the boiler, by the agitation incident to the opening of the, so-called, *safety*-valve, the alarming fact was presented that the very instrument provided for insuring against explosions might become the cause of producing one.

These considerations naturally led to the conclusion that safety was alone to be attained by opening a water blow-off valve, when the surface of the water had fallen to a perilous extent, for the purpose of first discharging from the boiler the water, which was the more dangerous element, and then the steam; operating, in fact, as a safety-valve in a more useful but less objectionable position than the present steam-valve, situated on the dome. The arrangement represented by the wood-cut illustrated the principle; it represented a valve communicating with the water, and kept in position by a rod which served for its stem, and terminated in a button cemented with tin, or other readily fusible metal, into a copper cup, rivetted to the crown of the furnace. There were no working-joints or stuffing-boxes to become disordered, and the fusible metal was protected by the cup, composed of a material which was a rapid conductor of heat. If the furnace should be unduly heated the button would be released, and the valve permitted to open and discharge the water and steam from the boiler. The boiler might be injured, and the flues destroyed by the fire, but no explosion could occur. This system had been subjected to trial under heavy pressure, and had been found very successful.

In the discussion it was argued that Mr. Hall's system, if properly carried out, would be extremely useful, and almost prevent the possibility of danger from explosion; but that it would be of use only when an explosion was almost inevitable, and that as prevention was better than cure, the utmost should first be done to prevent boilers reaching that state, still retaining Mr. Hall's valuable apparatus, in case of all other means of prevention proving ineffectual. The majority of explosions were stated to arise from the practice of constructing the boilers with the fire-places in the flues, contrary to the system used in Cornwall, where they always arranged to have abundant boiler room and slow combustion; but where flue-firing was used the boiler surface was too frequently deficient, and the firing rapid and generally forced. Plans were exhibited, showing this peculiar danger to be caused by the severest action of the fire being, of necessity, within the concavity of the fire-flue, upon which there was but a few inches depth of water, and where the least neglect in its supply would be fatal to the boiler-plate, even if a repulsive action did not already cause a remittent rather than a constant action of contact of water with the plate; besides which, the probability of the water below the fire-bars not boiling at all rendered the supply of steam weak and easily exhausted, and led to undue firing and all its concomitant evils. Many extracts from known writers bearing on the subject were given, and it was attempted to be shown that while there were fully as many under-firing as tube-firing boilers at work, the majority of explosions took place in boilers of the latter class, and they almost invariably commenced with the collapse of the fire-flue.

It was contended that the only objection which could be raised against under-firing was the danger of incrustation or deposit upon the boiler bottom of matter held in suspension by the water; but that this rarely, if ever, caused explosions: the utmost injury it occasioned was causing the boiler-plate to be burnt out, and that this effect could not take place without gross neglect. The questions of the possibility of saturating surcharged steam so as to dangerously increase its power, of hydrogen gas being formed in the boiler, and other theories of a similar nature were avoided, as it was held that each of these, supposing their possibility, must arise from the presence of unduly heated metal within the boiler, which it could not be doubted was the prime cause of nearly all explosions, and that a properly set under-firing boiler could never, except from the most culpable neglect, have any portion of its surface overheated. It was also suggested that, when it was necessary to stop the engines, instead of closing the damper, it would be safer to leave it open,—to close the ash-pit door, and to keep the fire-door ajar.

The possibility of the water being repelled from the top of the flue, as previously remarked, was contested; and it was argued that the water would rather have a tendency to rise up the two sides of the tube, on account of the fire being in immediate contact with the side plates, and thus that the two currents would cause the water rather to heap up over the flue.

Many flue boilers were injured by the flame being allowed to impinge too sharply upon certain parts, and in those spots the plates blistered and were soon burned through; the best remedy for this was to give more flue space; and it would be found that the quantity of steam generated would be increased, whilst the burning of the boiler would be prevented. In many cases of explosion, especially of locomotive boilers, it was evident that the pressure had increased very gradually, and the steam had become surcharged with heat, so that when the explosion occurred, all the water was suddenly flashed into steam, as the rails and ground all around were quite dry.

The spheroidal theory of M. Boutigny (D'Evreux) was discussed, and a doubt was expressed whether any considerable quantity of water could be brought into the same state as the small quantities upon which his experiments were tried. It was, however, contended, that if a boiler was heated to a very high temperature whilst empty, and the water was then suddenly injected and the aperture closed, an explosion would not occur instantly, because the water would have assumed the spheroidal state; but as soon as the temperature was reduced to the proper degree, the steam would be liberated in such a volume, and at such a density, as to burst the boiler.

In Cornwall, where it was acknowledged that the utmost economy of fuel was practised, the boilers were stated to be nearly all on the internal flue principle, and an accident was scarcely ever known to occur there. It was generally admitted that the apparatus introduced by Mr. Hall would be effective in preventing accidents, but that the main point was to have very ample boiler space, and encourage great attention on the part of the engine attendant.

March 11, 1856.

The discussion was renewed, and continued throughout the evening.

A new form of boiler was exhibited, and described as having been recently erected at the works of Messrs. Humphrys, Tennant, and Dykes; the fire-box, of 3 ft. diameter, was composed of a series of flanged rings of Low Moor iron, fastened together in such a manner as that the rivets should be surrounded by water, and not be exposed to the action of the fire. The depth of water over the fire-box would be double that over the small iron flues or tubes, which were 3 in. diameter. No double thickness of plate was allowed anywhere. It was intended to supply steam of 70 lbs. per inch, and it had been loaded up to 120 lbs. per inch. The shell was much stronger than that of one of the Great Western locomotives, and it was anticipated that the steam might be permitted to accumulate without danger.

Several instances were given of explosions of locomotive boilers, presenting many apparent peculiarities, which were, however, all referable to natural causes; in some cases, a series of very peculiar circular holes, and in others grooves, were found, extending all round the interior of the shell, near the rivets. The boilers had failed below the part where they were weakened by the bending over, probably a little too sharply, of the plates.

When it was remembered that the explosion of a boiler under a pressure of 140 lbs. per square inch was nearly identical with that of a 10-inch gun, the effects of such an occurrence were not surprising.

In the cotton mills the speeds of the machinery were increased, whilst the boilers became weaker from wear; under such circumstances the occurrence of accidents was scarcely to be wondered at. When steam ceased to act merely by pressure, and began to exercise momentum, peculiar effects must be anticipated; but they might all be traced to general, rather than to occult, causes.

It was stated that nearly, if not quite all, the instances of explosions recorded in the "Journal of the Franklin Institute" were from boilers with under-firing, and they were generally considered in the United States as less secure than those with internal fire-flues.

It was stated, relative to the explosion at Sheffield, that it was proved there had been a sufficiency of water over the tube, and yet that one portion of it must have been red-hot; at least, such was the appearance exhibited. It was contended that the effect of heaping up the water from the action of the side-plates was not nearly so probable as the repulsive action of the top of the flue, previously contended for. Also, that if, as had been stated, the water below the flue was unduly cooled at that part, the steam would be weak and deficient in quantity. It was reiterated that, if a boiler was of due strength, properly set, and carefully attended to, there was little danger of explosion, until the plates were too much weakened by wear and tear. With all boilers, Mr. Hall's apparatus would be a valuable adjunct, and in no case could it be prejudicial.

The double-flue Cornish boiler was mentioued as being preferable to the single firing-flue;—the surface exposed was more extensive, and the construction was stronger, the depth of water above the flues was greater, and firing could be alternate. All these were admitted advantages.

It was reiterated that it was not necessary to have recourse to the spheroidal theory—to the decomposition of water—or to any highly scientific arguments, and much less to mysterious or occult causes, for the reasons of explosions. Careful investigation would in general point sufficiently clearly to them when the reasons were fairly sought for.

It was stated that the observed cases of corrosion of the plates of boilers might be referred to galvanic agency, and instances were given of such effects being produced when the bilge-water was taken up by the feed-pumps and injected into the boilers. The sections of metal torn asunder frequently presented proof of an instantaneous generation of explosive power, whether produced by overheated plates or any other cause; and as the method of discharging the water and the steam from a boiler, and extinguishing the fire, would appear to be the most effectual mode of preventing danger, it would be only reasonable to employ so simple a precaution as that afforded by Mr. Hall's apparatus.

The opinion as to the little confidence to be placed in self-acting apparatuses in general was agreed with; bnt it was submitted that the self-acting looms, and other machines of that class, and the automatic action of the eccentric upon valve-gear and other similar arrangements, would warrant deviation from the rule, under certain circumstances, among which might be placed the spontaneous discharge of the water and steam from the boiler when in a dangerons condition.

The experiments of Watt and Southern were alluded to as demonstrating that the latent heat of steam, at high temperatures, was progressively converted into thermometric heat, and the injection of water into surcharged steam would occasion a proportionate increase of pressure. A careful investigation of this subject would, probably, confirm the alleged resnlt of the experiments undertaken for Mr. E. K. Collins, of New York, which appeared to be that a saving of nearly 50 per cent. of fuel might be made by the use of surcharged steam.

The decomposition of water on heated plates, although admitted to be an interesting chemical study, was now generally rejected as a practical solution of the question of explosion; and as to the spheroidal theory, any snch pressure of steam as must exist within a boiler would practically force the water into absolute contact with the heated surface, and would not permit the globules to be suspended amidst the film of steam, at atmospheric pressure, as in an open crucible, or on a plain heated plate. Therefore, that theory must almost be abandoned in practice.

The causes of explosions might, at first sight, appear to be difficult of discovery, but careful investigation generally brought to light evidence of some condition of the boiler, under which an accident would be inevitable. The difficulty of arriving at the facts was great, after the occurrence of explosions, but there were few cases which did not exhibit undue weakness in some parts of the boiler, or undue steam pressure, without adequate means of affording relief.

In the case of the explosion of the locomotive boiler which had been mentioned, it was well ascertained that the cross stays upon the fire-box top were rather too short, and thus had their bearing inside, instead of upon the exterior periphery. Explosions might be generally attributed to equally simple causes, and it was impressed on the meeting to seek for them, rather than to raise theories upon some occult causes, the existence of which was very problematical.

Mr. Hall's apparatus might, with advantage, be applied to all boilers, and would be more useful if, as an invariable adjunct, it could take with it a careful and intelligent fireman.

[We have given the above abstract of Mr. Hall's paper and the discussions at the Institution of Civil Engineers in as complete a form as our space would admit, for the reason that while it fully endorses the views we have frequently expressed, the details of the accidents to which it refers may be found in the columns of THE ARTIZAN. It is generally admitted that explosions are occasioned by heated metal, and every one possessing a boiler has probably instructed his stoker to draw the fires and shut off the pumps immediately that a deficiency of water has been discovered; but it is not so well known or considered that water may be supplied and the impending catastrophe hastened by opening the steam or safety-valve. It appears then a reasonable deduction, that safety can only be ensured by discharging the water and extinguishing the fire; and if these operations can be performed by an apparatus such as has been suggested, requiring no delicacy of adjustment, and with no working parts to become deranged, a great safeguard has been attained.

Self-acting apparatus has been deprecated, and reliance upon the intelligence of man advised. As a result of dependence upon the persons to whom boilers have been entrusted, there were half a dozen explosions in England last summer in as many weeks, and two within one week at Sheffield. If looms and printing presses were less self-acting, we should neither have Manchester goods covering the world nor a million of newspapers on the breakfast-tables of Great Britain every morning. It is said that the valves of the first pumping-engines were reversed by boys, one of whom applied a string and weight to perform his duty. If the movements of the valves of steam-engines were now performed through the direct intervention of living intelligence instead of self-acting eccentrics, there would not be many in operation. When a mechanical movement is desired and the means are adapted to the end, there can be nothing better than mere matter acting under the immutable laws of nature.

We have been present at some of the experiments with this valve, and can testify to the perfection of its operation. It is correct in principle, simple in construction, and applicable to all forms of boilers, and should be applied to every steam-boiler in operation.—ED.]

NEW LINE OF SCREW STEAMERS.

HAVRE TO BRAZIL.

THE *Cadiz*, the first of this line, belonging to the Franco-American Company, Messrs. Gauthier Frères, of Paris, gérants, left Liverpool for her port of departure at the end of last month. This fine vessel is about 1,670 tons burthen (builder's measurement), and was constructed by Mr. Laird. The engines are by Messrs. G. Rennie and Sons, of Blackfriars, London, and are on the system recently patented by them, which has been adopted in all the vessels on the line. They are of 300 H.P. collectively, with a diameter of cylinder of 56 in. and 2 ft. 6 in. stroke. On starting for the trial trip, the dranght of water was 19 ft. 9 in. aft, 16 ft. 5 in. forward, giving a main draught of 17 ft. 1 in., with a displacement of 23·85 tons. The following are some particulars of her trip:—

2.3 .... Passed Rock Light.
2.15......... Eased engines.

The tug which had accompanied the vessel out of Liverpool, upon finding that the vessel was gaining upon it, left at 2.25, and at 2.30 the vessel went on at full speed for her destination. The weather was somewhat boisterous during the voyage, which is none of the best at any time, and on the next day but one, at 10.5 A.M., she sighted the Lizard Light: at 2.20 was abreast of the Eddystone, a strong breeze from the south-east blowing all the time. This somewhat reduced the revolution of the engines, then making about 54 to 55 per minute, and running at a speed of 10 knots through the water. At 2.30 P.M. on the same day, with a head wind, she was making 60 to 63 revolutions, with plenty of steam: at this time she was making 12 knots through the water. The excellent workmanship of the engines may be imagined when we say that, without having had a trial trip, they were set to work on leaving the Mersey, and never once stopped till the vessel reached Havre, and without any heating or other inconvenience. We believe this to be a case almost without precedent.

After a stoppage of a few days at Havre to take on board her cargo, and overhaul, to see that everything was in accordance with the French Government rules, she left for the Brazils. *Le Lyonnais*, a sister vessel, is now nearly ready, and will, no doubt, be equally efficient in every respect. The air-pumps are single acting plunger pumps, and the engines in this, as in other respects, similar to what have been fitted by the same firm to the vessels of the Sardinian Transatlantic Company, the Mexican Government, the British Home and Colonial Governments, and others: they combine extreme simplicity with easy repair of every part.

SCREW PROPELLERS.—SPEED IN STATUTE MILES* PER HOUR.†

Pitch of Screw.	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Pitch of Screw.
	NUMBER OF REVOLUTIONS OF SCREW PER MINUTE.																										
ft. in.																											ft. in.
4 0	110·00	132·00	154·00	176·00	198·00	220·00	242·00	264·00	286·00	308·00	330·00	352·00	374·00	396·00	418·00	440·00	462·00	484·00	506·00	528·00	550·00	572·00	594·00	616·00	638·00	660·00	4 0
4 6	97·77	117·33	136·88	156·44	176·00	195·55	215·11	234·66	254·22	273·77	293·33	312·88	332·44	352·00	371·55	391·11	410·66	430·22	449·77	469·33	488·88	508·44	528·00	547·55	567·11	586·66	4 6
5 0	88·00	105·60	123·20	140·80	158·40	176·00	193·60	211·20	228·80	246·40	264·00	281·60	299·20	316·80	334·40	352·00	369·60	387·20	404·80	422·40	440·00	457·60	475·20	492·80	510·40	528·00	5 0
5 6	80·00	96·00	112·00	128·00	144·00	160·00	176·00	192·00	208·00	224·00	240·00	256·00	272·00	288·00	304·00	320·00	336·00	352·00	368·00	384·00	400·00	416·00	432·00	448·00	464·00	480·00	5 6
6 0	73·33	88·00	102·66	117·33	132·00	146·66	161·33	176·00	190·66	205·33	220·00	234·66	249·33	264·00	278·66	293·33	308·00	322·66	337·33	352·00	366·66	381·33	396·00	410·66	425·33	440·00	6 0
6 6	67·69	81·23	94·75	108·30	121·84	135·38	148·92	162·45	176·00	189·53	203·07	216·61	230·14	243·68	257·22	270·76	284·30	297·83	311·37	324·91	338·45	351·98	365·52	379·06	392·60	406·14	6 6
7 0	62·85	75·42	88·00	100·56	113·14	125·71	138·28	150·85	163·45	176·00	188·56	201·13	213·71	226·27	238·85	251·42	264·00	276·56	289·13	301·70	314·27	326·85	339·42	352·00	364·56	377·13	7 0
7 6	58·66	70·40	82·13	93·87	105·60	117·33	129·07	140·80	152·53	164·27	176·00	187·73	199·47	211·20	222·93	234·66	246·40	258·13	269·87	281·60	293·33	305·07	316·80	328·53	340·27	352·00	7 6
8 0	55·00	66·00	77·00	88·00	99·00	110·00	121·00	132·00	143·00	154·00	165·00	176·00	187·00	198·00	209·00	220·00	231·00	242·00	253·00	264·00	275·00	286·00	297·00	308·00	319·00	330·00	8 0
8 6	51·76	62·11	72·46	82·82	93·17	103·52	113·87	124·22	134·58	144·93	155·28	165·63	176·00	186·34	196·69	207·04	217·39	227·74	238·10	248·45	258·80	269·15	279·50	289·86	300·21	310·56	8 6
9 0	48·88	58·66	68·44	78·22	88·00	97·77	107·55	117·33	127·11	136·88	146·66	156·44	166·22	176·00	185·77	195·55	205·33	215·11	224·88	234·66	244·44	254·22	264·00	273·77	283·55	293·33	9 0
9 6	46·31	55·58	64·84	74·10	83·37	92·63	101·89	111·16	120·42	129·68	138·94	148·21	157·47	166·73	176·00	185·26	194·52	203·79	213·05	222·31	231·57	240·84	250·10	259·36	268·63	277·89	9 6
10 0	44·00	52·80	61·60	70·40	79·20	88·00	96·80	105·60	114·40	123·20	132·00	140·80	149·60	158·40	167·20	176·00	184·80	193·60	202·40	211·20	220·00	228·80	237·60	246·40	255·20	264·00	10 0
10 6	41·90	50·20	58·67	67·05	75·43	83·81	92·19	100·57	108·57	117·33	125·71	134·10	142·48	150·86	159·24	167·62	176·00	184·38	192·76	201·14	209·52	217·91	226·29	234·67	243·05	251·43	10 6
11 0	40·00	48·00	56·00	64·00	72·00	80·00	88·00	96·00	104·00	112·00	120·00	128·00	136·00	144·00	152·00	160·00	168·00	176·00	184·00	192·00	200·00	208·00	216·00	224·00	232·00	240·00	11 0
11 6	38·26	45·91	53·56	61·22	68·87	76·52	84·17	91·82	99·48	107·13	114·78	122·43	130·08	137·74	145·39	153·04	160·69	168·34	176·00	183·65	191·30	198·95	206·60	214·26	221·91	229·56	11 6
12 0	36·66	44·00	51·33	58·66	66·00	73·33	80·66	87·99	95·33	102·66	109·99	117·33	124·66	132·00	139·33	146·66	154·00	161·33	168·66	176·00	183·33	190·66	198·00	205·33	212·66	220·00	12 0
12 6	35·20	42·24	49·28	56·32	63·36	70·40	77·44	84·48	91·52	98·56	105·60	112·64	119·68	126·72	133·76	140·80	147·84	154·88	161·92	168·96	176·00	183·04	190·08	197·12	204·16	211·20	12 6
13 0	33·84	40·61	47·38	54·20	60·92	67·69	74·96	81·22	87·99	94·76	101·53	108·30	115·07	121·84	128·61	135·38	142·15	148·91	155·68	162·45	169·22	176·00	182·76	189·53	196·30	203·07	13 0
13 6	32·59	39·11	45·63	52·14	58·66	65·18	71·70	78·22	84·73	91·25	97·77	104·29	110·81	117·32	123·84	130·36	136·88	143·40	149·91	156·43	162·95	169·47	176·00	182·50	189·02	195·54	13 6
14 0	31·42	37·71	44·00	50·28	56·57	62·85	69·14	75·42	81·71	87·99	94·28	100·56	106·85	113·13	119·42	125·70	132·00	138·28	144·56	150·85	157·13	163·42	169·71	176·00	182·28	188·55	14 0
14 6	30·34	36·41	42·48	48·55	54·62	60·69	66·76	72·83	78·90	84·97	91·03	97·10	103·17	109·24	115·31	121·38	127·45	133·52	139·59	145·66	151·72	157·79	163·86	169·93	176·00	182·07	14 6
15 0	29·33	35·20	41·06	46·93	52·80	58·66	64·53	70·40	76·26	82·13	88·00	93·86	99·73	105·60	111·46	117·33	123·20	129·06	134·93	140·80	146·66	152·53	158·40	164·26	170·13	176·00	15 0
15 6	28·38	34·06	39·73	45·41	51·08	56·76	62·44	68·11	73·79	79·46	85·14	90·82	96·49	102·17	107·84	113·52	119·20	124·87	130·55	136·22	141·90	147·58	153·25	158·93	164·60	170·28	15 6
16 0	27·50	33·00	38·50	44·00	49·50	55·00	60·50	66·00	71·50	77·00	82·50	88·00	93·50	99·00	104·50	110·00	115·50	121·00	126·50	132·00	137·50	143·00	148·50	154·00	159·50	165·00	16 0
16 6	26·66	32·00	37·33	42·66	48·00	53·33	58·66	64·00	69·33	74·66	80·00	85·33	90·66	96·00	101·33	106·66	112·00	117·33	122·66	128·00	133·33	138·66	144·00	150·33	155·66	160·00	16 6
17 0	25·88	31·05	36·23	41·41	46·58	51·76	56·93	62·11	67·29	72·46	77·64	82·81	88·00	93·17	98·34	103·52	108·69	113·87	119·05	124·22	129·40	134·57	139·75	144·93	150·10	155·28	17 0
17 6	25·14	30·17	35·20	40·22	45·25	50·28	55·31	60·34	65·36	70·39	75·42	80·45	85·48	90·50	95·53	100·56	105·59	110·62	115·64	120·67	125·70	130·73	135·76	140·78	145·81	150·84	17 6
18 0	24·44	29·33	34·22	39·11	44·00	48·88	53·77	58·66	63·55	68·44	73·33	78·22	83·11	88·00	92·88	97·76	102·66	107·55	112·44	117·33	122·22	127·11	132·00	136·88	141·77	146·64	18 0
18 6	23·78	28·54	33·29	38·05	42·80	47·56	52·32	57·07	61·83	66·58	71·34	76·10	80·85	85·61	90·36	95·12	99·88	104·63	109·39	114·14	118·90	123·66	128·41	133·17	137·92	142·68	18 6
19 0	23·14	27·79	32·42	37·05	41·68	46·28	50·94	55·58	60·21	64·84	69·47	74·10	78·73	83·36	88·00	92·56	97·26	101·89	106·52	111·15	115·78	120·42	125·05	129·68	134·31	138·84	19 0
19 6	22·56	27·07	31·58	36·10	40·61	45·12	49·63	54·14	58·66	63·17	67·68	72·19	76·70	81·22	85·73	90·24	94·75	99·26	103·78	108·29	112·80	117·31	121·82	126·34	130·85	135·30	19 6
20 0	22·00	26·40	30·80	35·70	39·60	44·00	48·40	52·82	57·20	61·60	66·00	70·40	74·80	79·20	83·60	88·00	92·40	96·80	101·20	105·60	110·00	114·40	118·80	123·20	127·60	132·00	20 0
20 6	21·46	25·75	30·04	34·34	38·63	42·92	47·21	51·50	55·80	60·09	64·38	68·67	72·96	77·26	81·55	85·84	90·13	94·42	98·72	103·01	107·30	111·50	115·88	120·18	124·47	128·76	20 6
21 0	20·95	25·14	29·33	33·02	37·71	41·90	46·09	50·28	54·47	58·66	62·85	67·05	71·24	75·43	79·61	83·81	88·00	92·19	96·38	100·57	104·76	108·95	113·14	117·33	121·52	125·70	21 0
21 6	20·46	24·56	28·65	32·74	36·84	40·93	45·02	49·12	53·21	57·30	61·39	65·49	69·58	73·67	77·77	81·86	85·95	90·05	94·14	98·23	102·32	106·42	110·51	114·60	118·70	122·79	21 6
22 0	20·00	24·00	28·00	32·00	36·00	40·00	44·00	48·00	52·00	56·00	60·00	64·00	68·00	72·00	76·00	80·00	84·00	88·00	92·00	96·00	100·00	104·00	108·00	112·00	116·00	120·00	22 0
22 6	19·55	23·47	27·38	31·29	35·20	39·11	43·02	46·93	50·84	54·75	58·66	62·58	66·49	70·40	74·31	78·22	82·13	86·04	89·95	93·86	97·77	101·66	105·60	109·51	113·42	117·33	22 6
23 0	19·13	22·95	26·78	30·61	34·43	38·26	42·08	45·91	49·24	53·56	57·39	61·21	65·04	68·87	72·69	76·52	80·34	84·17	88·00	91·82	95·65	99·47	103·30	107·13	110·95	114·78	23 0
23 6	18·72	22·46	26·21	29·95	33·70	37·44	41·18	44·93	48·67	52·42	56·16	59·90	63·65	67·39	71·14	74·88	78·62	82·37	86·11	89·86	93·60	97·34	101·09	104·83	108·58	112·32	23 6
24 0	18·33	22·00	25·66	29·33	33·00	36·66	40·33	44·00	47·66	51·33	55·00	58·66	62·33	66·00	69·66	73·32	77·00	80·66	84·33	88·00	91·66	95·33	99·00	102·66	106·33	110·00	24 0
24 6	17·96	21·55	25·14	28·74	32·33	35·92	39·51	43·10	46·70	50·28	53·88	57·47	61·06	64·66	68·25	71·84	75·43	79·02	82·62	86·21	89·80	93·30	96·98	100·58	104·17	107·76	24 6
25 0	17·60	21·12	24·64	28·16	31·68	35·20	38·72	42·24	45·76	49·28	52·80	56·32	59·84	63·36	66·88	70·40	73·92	77·44	80·96	84·48	88·00	91·52	95·04	98·56	102·08	105·60	25 0

* 1 Statute mile = 5,280 ft.

† These TABLES are given to facilitate the calculation of the theoretical proportions of screw-propellers suited to various speeds, and, together with the letter of Mr. Collins (given at page 90), will, doubtless, be found of service.

SCREW PROPELLERS.—SPEED IN KNOTS* PER HOUR.

Pitch of Screw. ft. in.	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Pitch of Screw. ft. in.
	NUMBER OF REVOLUTIONS OF SCREW PER MINUTE.																										
4 0	126·72	152·07	177·41	202·75	228·10	253·44	278·79	304·13	329·48	354·82	380·17	405·51	430·85	456·20	481·54	506·89	532·23	557·58	582·63	608·26	633·61	658·95	684·3	709·64	734·60	760·33	4 0
4 6	112·64	135·17	157·71	180·23	202·75	225·28	247·81	270·34	292·87	315·40	337·62	360·45	382·98	405·51	428·04	450·57	473·10	495·62	518·15	540·68	563·21	585·74	608·26	630·79	653·32	675·85	4 6
5 0	101·38	121·65	141·93	162·20	182·48	202·75	223·03	243·31	263·59	283·86	304·13	324·41	344·68	364·96	385·23	405·51	425·78	446·06	460·34	486·61	506·89	527·16	547·44	567·71	587·99	608·26	5 6
5 6	62·16	110·56	129·03	147·46	165·89	184·32	202·75	221·19	239·62	258·05	276·48	294·62	313·35	331·78	350·21	368·64	387·08	405·51	423·94	442·37	460·81	479·24	497·67	516·10	534·53	552·97	5 6
6 0	84·48	101·37	118·27	135·17	152·06	168·96	185·86	202·75	219·65	236·55	253·44	270·34	287·24	304·13	321·30	337·93	354·82	371·72	388·61	405·51	422·41	439·30	456·2	473·10	489·99	506·80	6 0
6 6	77·98	93·58	109·17	124·77	140·37	155·96	171·56	187·15	202·75	218·35	233·95	246·54	265·14	280·73	296·33	311·93	327·52	343·12	358·72	374·31	389·91	405·50	421·10	436·70	452·29	467·60	6 6
7 0	72·41	86·90	101·38	115·86	130·34	144·82	159·31	173·79	188·27	202·75	217·24	232·72	246·20	260·68	275·17	289·65	304·13	318·61	333·10	347·58	3 2·06	376·54	391·03	405·51	420·00	434·48	7 0
7 6	67·58	81·10	94·62	108·14	121·65	135·17	148·69	162·20	175·72	189·24	202·75	216·27	229·79	243·30	256·82	270·34	283·86	297·37	310·89	324·41	337·92	351·44	364·06	378·48	392·00	405·51	7 6
8 0	63·36	76·03	88·70	101·38	114·05	126·72	139·36	152·07	164·74	177·41	190·08	202·75	215·43	228·10	240·77	253·44	266·12	278·79	291·46	304·13	316·80	326·47	342·15	354·82	367·50	380·17	8 0
8 6	59·63	71·56	83·49	95·41	107·34	116·27	131·20	143·12	155·05	166·97	178·60	160·83	202·75	214·68	226·61	238·53	250·46	262·39	274·31	286·24	298·17	310·10	322·02	330·95	345·87	357·80	8 6
9 0	56·32	67·58	78·85	90·11	101·38	112·64	123·90	135·17	146·43	157·70	168·96	180·23	191·50	202·75	214·20	225·28	236·55	247·81	259·08	270·34	281·60	202·87	301·13	315·40	326·66	337·92	9 0
9 6	53·36	64·03	74·70	85·37	96·04	106·71	117·38	128·05	138·73	149·40	160·07	170·74	181·41	162·08	202·75	213·42	224·10	234·77	245·44	256·11	266·78	277·45	288·12	203·80	306·47	320·14	9 6
10 0	50·69	60·82	70·66	81·10	91·24	101·38	111·51	121·65	131·79	141·93	152·06	162·20	172·31	182·43	192·62	202·75	212·89	223·03	233·17	243·30	253·44	263·58	273·72	283·85	294·00	304·13	10 6
10 6	48·27	57·93	67·58	77·24	86·89	96·55	106·20	115·86	125·51	135·17	144·82	154·48	164·13	173·79	183·44	193·10	202·75	212·41	222·06	231·72	241·37	251·03	260·68	270·31	280·00	289·65	10 6
11 0	46·08	55·30	64·51	73·73	82·94	92·16	101·38	110·59	119·81	129·02	138·24	147·46	156·67	165·89	175·10	183·32	193·54	202·75	211·97	221·19	230·40	239·62	248·83	258·05	267·27	276·48	11 0
11 6	44·08	52·89	61·70	70·52	79·34	88·15	96·97	105·78	114·60	123·41	132·23	141·07	146·87	158·68	167·49	176·31	185·12	193·94	202·75	211·57	220·38	229·20	238·01	246·83	255·65	264·46	11 6
12 0	42·24	50·68	59·14	67·58	76·03	84·48	92·93	101·38	109·82	118·27	126·72	135·17	143·62	152·07	160·51	168·96	177·41	185·86	164·31	202·75	211·20	219·65	228·10	236·55	245·00	253·44	12 0
12 6	40·55	48·66	56·77	64·88	73·00	81·10	89·21	97·32	105·43	113·54	121·65	129·76	137·87	145·98	154·09	162·20	170·31	178·42	186·53	194·64	202·75	210·86	218·97	227·08	235·16	243·30	12 6
13 0	39·00	46·79	54·59	62·38	70·18	77·98	85·78	93·58	101·38	109·17	116·67	124·77	132·57	140·37	148·16	155·96	163·76	171·56	179·36	187·16	164·95	202·75	210·55	218·35	226·15	233·65	13 0
13 6	37·54	45·06	52·56	60·07	67·58	75·09	82·60	90·11	97·62	105·13	112·64	120·15	127·66	135·17	142·68	150·19	157·70	165·21	172·72	180·22	187·73	195·24	202·75	210·26	217·78	225·28	13 6
14 0	36·21	43·45	50·69	57·93	65·17	72·41	79·65	86·89	94·14	101·38	108·62	115·68	123·10	130·34	137·58	144·82	152·07	159·31	166·55	173·80	181·03	183·27	195·01	202·75	210·00	217·24	14 0
14 6	34·66	41·95	48·94	55·93	62·92	69·91	76·91	83·90	90·86	97·88	104·87	111·86	118·35	125·85	132·84	139·83	146·82	153·81	160·80	167·80	174·79	181·78	188·77	105·76	202·7	206·74	14 6
15 0	33·79	40·55	47·31	54·07	60·83	67·58	74·34	81·10	87·86	94·62	101·38	108·14	114·86	121·65	128·41	135·17	141·93	148·60	155·44	162·20	168·96	175·72	182·48	189·24	166·00	202·75	15 0
15 6	32·70	39·24	45·78	52·32	58·86	65·40	71·94	78·49	85·03	91·57	98·11	104·65	111·19	117·73	124·27	130·81	137·35	143·89	150·43	156·67	163·51	170·05	176·59	183·13	189·67	196·21	15 6
16 0	31·68	38·02	44·35	50·69	57·02	63·36	69·70	76·03	82·37	88·70	65·04	101·38	107·71	114·05	120·38	126·72	133·06	139·39	145·73	152·07	158·40	164·74	171·07	177·41	183·75	190·08	16 0
16 6	30·72	36·86	43·01	49·15	55·30	61·44	67·58	73·73	79·87	86·02	92·16	98·30	104·45	110·56	116·74	122·88	129·02	135·17	141·31	147·45	153·60	159·74	165·89	172·03	178·18	184·32	16 6
17 0	29·82	35·78	41·74	47·71	53·67	59·63	65·60	71·56	77·52	83·49	89·45	95·41	101·38	107·34	113·30	119·27	125·23	131·19	137·16	143·12	149·10	155·05	161·01	166·97	172·93	178·90	17 0
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19 0	26·68	32·01	37·35	42·68	48·02	53·36	58·69	64·03	69·36	74·70	80·03	85·37	90·76	96·04	101·38	106·71	112·05	117·3	122·72	128·05	133·40	138·72	144·00	149·40	154·73	160·07	19 0
19 6	26·00	31·19	36·39	41·59	46·79	52·00	57·19	62·39	67·58	72·78	77·68	83·18	88·38	93·58	98 78	103·98	109·17	114·37	119·57	124·77	129·67	135·17	140·37	145·57	150·76	155·96	19 6
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23 0	22·04	26·45	30·85	35·26	39·67	44·08	48·48	52·89	57·30	61·71	66·11	70·52	74·93	79·34	83·75	88·15	92·56	96·97	101·38	105·78	110·19	114·60	119·01	123·41	127·82	132·23	23 0
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25 0	20·27	24·33	28·38	32·44	36·49	40·55	44·60	48·66	52·71	56·77	60·83	64·88	68·94	73·00	77·05	81·10	85·16	89·21	63·27	97·32	101·38	105·43	109·49	113·54	117·60	121·65	25 0

* 1 Knot = 6,682·66 ft.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(*From our own Correspondent.*)

Southampton, March 17, 1856.

H.M.'s screw-steamer *Himalaya* has been docked here during the last week, and we are much pleased to observe that the lignum vitæ bearings applied to her screw-shaft, by Messrs. Penn, have worked remarkably well. Since the application of this material the vessel has run about 30,000 miles, during which time the engines have made about 8,000,000 revolutions. The total wear down in the stern-post does not exceed 1-8th in., which is, of course, very trifling for the work done. The screw-shaft is lined with brass at the part bearing on the wood, and this bearing is 18 in. diameter × 4 ft. long. The lignum vitæ is inserted into the cast-iron stern-pipe in segments, each piece being the whole length of bearing, and about 3 in. wide × 3-4ths in. thick, so that the segments combine into the form of the pipe, in a somewhat similar way as the staves of a cask. The abutting edges of these segments are rounded off to form water-ways, and their surfaces are also scored in several places to allow a free circulation of water on every part of them. These segments are prevented from running round with shaft through its friction by a strip of metal, which is pinned on to the upper side of the stern-pipe, and against the edges of which the lignum vitæ segments abut. They are kept in at the inner end by a shoulder in the stern-pipe, and at the outer end by a ring, which is screwed on to the stern-post.

We are indebted to the courtesy of Mr. Gray, the engineer of the *Himalaya*, for a description of a very ingenious application of lignum vitæ which he has adopted in his collar or thrust-bearing. He found this bearing wore considerably, and when in the Mediterranean last year, the brass rings had thus become so reduced that there was a space of about ⅝ in. on the slack side of the collars. He determined to try the experiment of interposing lignum vitæ segments between the thrusting collars on the shaft and the brass rings on bearing, and fitted them in four segments of a circle to each collar, so that they can be slipped in their place without removing the bottom brass. They are prevented from running round with the shaft by a brass plate screwed on to the lower brass, and are so easily removed and refitted that two hours only are necessary for applying new segments to the block.

Mr. Gray finds that a set of lignum vitæ segments, thus applied, will last for from 7,000 to 10,000 miles, and the expense of fresh wood segments is very trifling.

We think that this plan is a very happy illustration of the old adage of "Necessity being the Mother of Invention," and doubt not that many of our sea-going readers will thank Mr. Gray for his novel application of materials.

Mr. Gray informs us that when the *Himalaya* has a clean bottom, and is in ordinary weather and without sails, she runs 1 mile with 250 revolutions of engines; but when her bottom becomes foul, from seven or eight months' running, it requires 300 revolutions of engines per mile run. This gives a slip of screw amounting to about 13 per cent. in one case and 27½ per cent. in the other, and shows what a dirty bottom will do in stopping the progress of an iron ship, and the great desideratum for some material which will arrest this fouling.

The *Belgique* is still here, and will, in all probability, remain for some time longer. On her last return to port, having, for the second time, failed in keeping at sea, she was surveyed here, in the first place by private surveyors, and, finally, the directors of the Company to which she belongs, having determined to insure her at Lloyds', her repairs and increased strengthening additions are now going on under the direction of their surveyors, the whole of the work being entrusted to Messrs. Summers and Day, of Northam. They consist chiefly in the addition of very strong fore and aft stringers and tie plates to her sides, the filling up, by plating, of the large cargo and gangway ports in her sides, and the application of proper stanchions to her decks. In addition to this a great deal of work is being done to her, the particulars of which we will lay before our readers in a future Number.

The Peninsular and Oriental Company's screw-steamer *Ava* arrived here with the mail from Alexandria last week. On her voyage out she had strong head winds to Gibraltar and Malta, and afterwards finer weather; homewards, generally fine weather. Her average speed out was 9·4 knots per hour; home, 11 knots; mean speed, 10·2 knots per hour. On her last trial at measured mile, January 30, 1856, this vessel gave an average speed of 12·429 knots per hour, the indicated H.P. being 1,056: draught forward, 15 ft. 3 in.; aft, 15 ft. 9 in.; total weight of coal, water, &c., on board = 601 tons; immersed midship section, 422 sq. ft.; co-efficient of immersed midship section, 767; slip of screw per cent. 6.

The *Ava* is a handsome iron vessel, by Messrs. Tod and McGregor. She is 266 ft. between perpendiculars, 35 ft. 2 in. beam, 25 ft. 6 in. deep, 1,613 tons, B. M. Her engines, by the same firm, are geared trunk engines; cylinders, 70 in. diameter × 4 ft. stroke; trunks, 30 in. diameter; effective diameter of cylinders = 66¾ in.; multiple of gear, 2¼ to 1; three-bladed screw, 14 ft. diameter × 19½ ft. pitch.

On a former trial at the measured mile, in August, 1855, her draught being 13 ft. 10 in. forward, and 14 ft. 5 in. aft, total weight on board 330 tons, her speed was 12·104 knots per hour; the indicated H.P. = 960.

To compare the results from these two trials we will first *suppose* that their conditions were the same in every respect but indicated H.P., then the theoretical speed obtained in the trial of August, 1855, with 960 H.P., should have been to that of January, 1856, as

$$\overset{\text{H.P.}}{1{,}056} : \overset{\text{Knots.}}{12{\cdot}429^3} :: \overset{\text{H.P.}}{960} : \overset{\text{Knots.}}{\sqrt[3]{12{\cdot}05}}$$

; and, as the actual speed was 12·104 knots, although the mean draught was 1 ft. 4½ in. less than in January, 1856, it follows that the advantage gained by diminished resistance of vessel was as nearly as possible neutralised by the diminished effective action of the propeller.

The screw steam-ship *Azof* arrived here last week for repairs. She is an iron vessel, by Messrs. Bourne and Co., and is fitted with a single engine, precisely the same in dimensions and design as the engine of the *Barwon*, engraved in The Artizan.

The screw-propeller is two-bladed, 13 ft. diameter × 14 ft. 6 in. pitch. The cylinder is 42 in. diameter and 42 in. stroke, and the average revolutions at sea are about 70 to 75.

The present tubular boilers are in four pieces, and are set in fire-bricks, like land engine boilers; they are now being removed by Messrs. Summers and Day, who are making two new boilers as a substitute, on Lamb and Summers' patent flue principle.

The single screw engine appears to work very well; it, however, requires a little management at starting to keep it from sticking on the centres, and when this occurs it requires seven or eight men to turn it off. The bearings of engine are very large, and well adapted for the high speed of piston obtained.

NOTES BY A PRACTICAL CHEMIST.

Lime in Silk.—It is not generally known that raw silk contains a certain quantity of lime, varying from 30 to 79 grammes to the kilogramme. The state of combination in which it occurs is still doubtful, though, as it is capable of extraction with acetic acid, it cannot be a phosphate.

The practical results of its presence are rather serious. The soap used in scouring the silk is decomposed by the lime with the formation of a calcareous soap, which causes fatty stains. These are spread out during the operation of calendering, and can only be partially removed by oil of turpentine. This evil may be considerably lessened by soaking the raw silk, previously to scouring, in dilute muriatic acid.

Silicium.—Some time ago a paragraph went the round of the non-scientific papers to the effect that silicium had been obtained in a new form, not to be distinguished from silver. The simple fact is, that it has been prepared in bluish scales of a metallic lustre, somewhat resembling graphite. M. St. Claire Deville has obtained silicium in a state analagous to the diamond, in hexagonal crystals, surmounted by a very acute pyramid.

The alloy of aluminium and silicium is of a deep iron grey colour.

IMPROVED COLORIMETER.—J. W. Slater proposes, instead of the ordinary tube colorimeter, a number of hoops of equal width cut off a wide glass tube, cemented down upon a slip of plate glass, and ground upon a polishing wheel, so as to form cells exactly equal in depth. These are then filled with the respective liquids to be compared, covered with a slip of glass, and held up to the light.

ANSWERS TO CORRESPONDENTS.

"S. N."—You are quite mistaken in supposing that medical men, as a body, are well versed in chemistry. When at college they attend lectures on that science, but rarely work in a laboratory.

"Perseus."—The seeds you mention are used in the adulteration of grain, though they have not yet been noticed by any authority.

REVIEWS.

The Year Book of Facts. Bogue, Fleet Street. 1856.

THIS annual miscellany of discoveries in science and the useful arts is again before us, undeteriorated in quality of matter and unamended as to arrangement. The complexion of the times is remarkably shown by the number of inventions bearing on military purposes. Of the precise value of these novelties we are little able to judge, but we decidedly lament the circumstances that have necessitated the withdrawal of so much talent from the arts of peace.

The great Paris Exhibition (not *exposition* as some of our contemporaries in their mania for exotic phrases love to call it) forms another prominent feature. This display differs remarkably from its prototype in Hyde Park. Superior by the admission of works of art as such, and displaying many important advances, it is unfortunate in having fallen on days of turmoil.

An explosion of gunpowder in the United States has elicited a number of curious remarks among local sages. Some fowls having been stripped of their feathers by the violence of the shock, a Professor Loomis could not understand this fact without the following experiment :—"He put a live fowl into a gun of 2 in. bore (? tight fit !) with a sixth of a charge of powder, and aimed at zenith." The result of this experiment was, we hope, perfectly satisfactory to the learned gentleman, for "it came down denuded of feathers !"

Mr. R. Hunt gives an interesting summary of our national mining industry. £34,000,000 may be taken as the value of the raw materials raised annually. "Hundreds of tons of the grey sulphuret of copper," he states, "have been thrown over the cliffs of the western shores into the Atlantic ocean, and hedges have been built with copper ores of twice the value of the ordinary copper pyrites."

A Mr. Wilkins has devised a new method of applying liquid manures. A waterproof floor is laid down under the field at a depth of 18 in., and into this isolated mass pipes convey the fertilising liquid. The returns are said to be astounding. Three annual crops, five cuttings of Italian rye grass, and that of superior quality, a yield of mangel-wurzel at the rate of 69 tons per acre are among the marvels. But when the inventor himself estimates the first outlay at from £50 to £100 per acre, practical men may well be excused if they pause before adopting so costly a system.

Our old friend the *Ericsson*, "caloric"-ship, has at last subsided into an ordinary steamer. We always felt a grudge at the inventor for the highly illogical name which he thought proper to give to his new motive power. "Caloric," if such a thing exist, was concerned as much in the Ericssonian engine as in the common steam-engine, and no more. The expansion of air being, instead of steam, the source of power, air-engine would have been the proper name. This might seem to some a trifle, but whatever tends to implant vague notions upon scientific subjects in the popular mind, is, in our opinion, a notable evil.

Further attempts are made to use atmospheric air saturated with the vapour of liquid hydrocarbons, instead of coal gas, for lighting and heating. We do not see any means of overcoming the old evil—the deposition of the hydrocarbons on traversing a long extent of piping, or on a fall of temperature.

The smoke-consumption question has excited much notice, and made little, very little progress. Amateurs still repeat the threadbare truism that carbon will be completely consumed if mingled with a due supply of oxygen. The point is, how to ensure such a mixture. When particles of carbon are enveloped with an atmosphere of carbonic acid their combustion becomes somewhat difficult.

The permanence of aluminium in the atmosphere seems well established. Might it not serve for the reflectors of lighthouses, and the specula of reflecting telescopes ?

Nature-printing, which was some time ago puffed as a discovery equal to photography, is beginning to find its due level. Illustrating no new law of science, and inapplicable, save for taking minute impressions of fern leaves, its value is not very high.

The paper difficulty may be regarded as at an end, since wood can be now rapidly and perfectly transformed into the authors' raw material.

Sir D. Brewster's theory of the triple spectrum, in opposition to the Newtonian doctrine of seven primary colours, appears to be gaining acceptance.

Lead, in a pure state, has been distinctly recognised as one of the constituents of meteorites.

A part of the chemical section of this volume is taken up with photography—a subject which is now rapidly losing its interest for the man of science, inasmuch as improved methods of preparing collodion are now more sought after than experiments calculated to explain the chemical action of light.

The chemical novelties contained in this volume are not remarkable, either for their number or importance—a circumstance, however, for which the editor is not responsible.

LIST OF NEW BOOKS OR NEW EDITIONS OF BOOKS.

BRITISH YEAR-BOOK for the Country, for 1856; being an Annual of Agriculture, Horticulture, Floriculture, and Arboriculture. Edited by C. M'Intosh and T. Lindley Kemp, M.D. 12mo, pp. 248, cloth, 4s. 6d. (Longman.)

ELLIOT (J.) Key to the Elementary Course of Practical Mathematics. By James Elliot. Part I—Algebra. 2nd edit. 12mo (Edinburgh), pp. 102, cloth, 2s. 6d. (Simpkin.)

FAIRBAIRN (W.)—Useful Information for Engineers; being a Series of Lectures delivered to the Working Engineers of Yorkshire and Lancashire; with a Series of Appendices, containing the results of Experimental Inquiries into the Strength of Materials, &c. By William Fairbairn. Royal 8vo, pp. 320, cloth, 15s. (Longman.)

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SQUIER (E. G.)—Notes on Central America, particularly the States of Honduras and San Salvador; their Geography, Topography, Climate, Population, Resources, Productions, &c. &c., and the proposed Honduras Inter-Oceanic Railway. By E. G. Squier. With Original Map and Illustrations. 8vo, pp. 396, cloth, 12s. (Low.)

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TIMBS (J.)—The Year Book of Facts in Science and Arts; exhibiting the most important Discoveries and Improvements of the past year in Mechanics and the useful Arts, &c. By John Timbs. 12mo, pp. 288, cloth, 5s. (Bogue.)

COOLEY (A. J.)—A Cyclopædia of Practical Receipts and Collateral Information in the Arts, Manufactures, Professions, and Trades; including Medicine, Pharmacy, and Domestic Economy: designed as a comprehensive Supplement to the Pharmacopœia, and General Book of Reference for the Manufacturer, Tradesman, Amateur, and Heads of Families. By Arnold J. Cooley. 3rd edition, 8vo, pp. 1344, cloth, 26s. (Churchill.)

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MURRAY (H.)—The Art of Painting and Drawing in Coloured Crayons; being a Course of Instruction for the Execution of Portraiture and Landscape. By Henry Murray. 12mo, pp. 60, sewed, 1s. (Winsor.)

RECENT ENGLISH PATENTS.

Governors or Regulators for Prime Movers. — J. H. Johnson, 47, *Lincoln's Inn Fields*. A communication.—[Sealed the 23rd November, 1855.]

This invention relates to a peculiar construction and arrangement of steam-engine or other governors or regulators, whereby greater com-

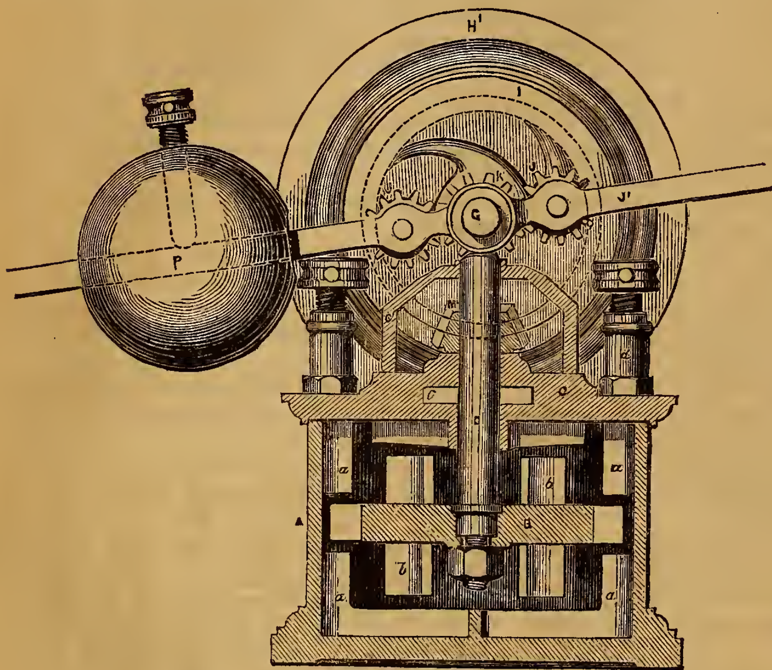


Fig. 1.

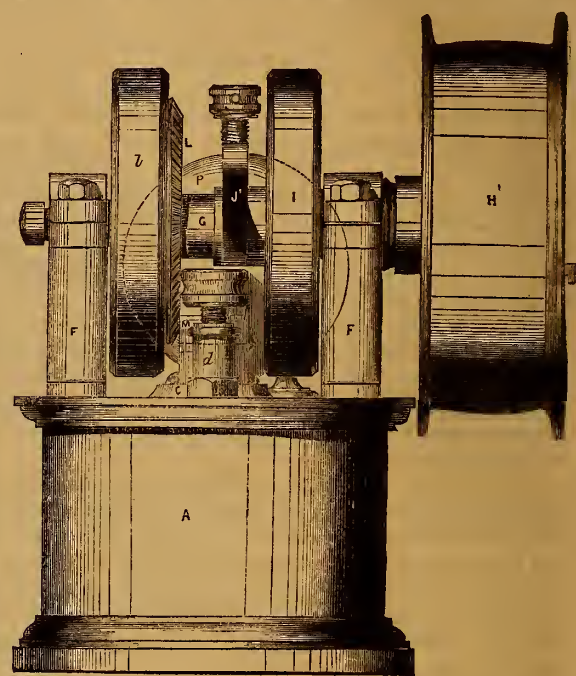


Fig. 2.

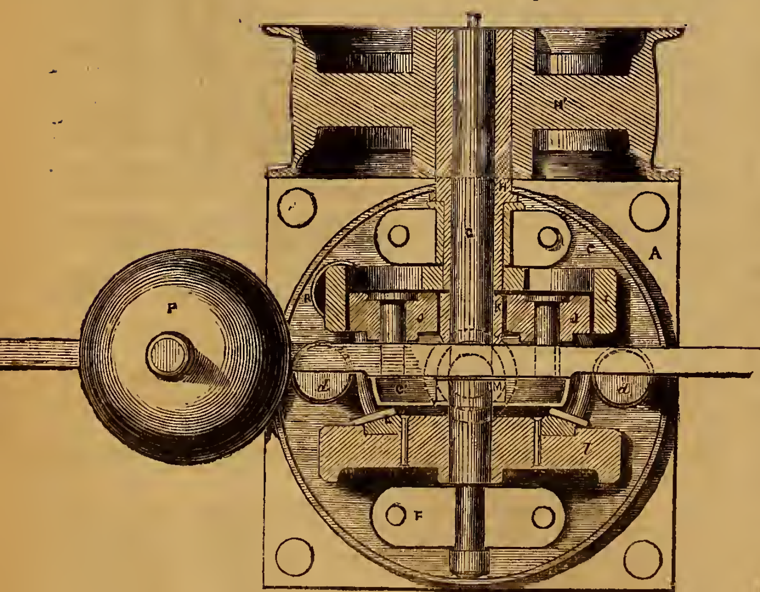


Fig. 3.

pactness and precision of working are obtained than in governors of the ordinary construction. The improved governor consists of a fan-wheel, rotating in water, oil, or any other suitable fluid contained inside a closed vessel or metal box, which box is fitted internally with fixed blades or stops to obstruct as much as possible the rotation of the fluid. This box serves as the support for the gearing of the apparatus. On the top of the vertical spindle which carries the fan-wheel is keyed a bevil pinion, gearing into a bevil-wheel which is screwed to a disc fast on a transverse shaft, passing through a tubular shaft which carries a driving pulley. This pulley has imparted to it the motion of the engine or machine to be regulated. On the opposite end of the tubular shaft to that which carries the driving pulley is fixed a spur-wheel with internal teeth gearing into two spur pinions running loose on stud-pins in a horizontal lever arm, the transverse shaft hereinbefore referred to forming the fulcrum of this lever. These two spur pinions gear with a corresponding spur pinion fast on the transverse shaft. The horizontal lever is connected at one end with the valve or other apparatus for controlling the engine or other prime mover, and is weighted at the other end to overcome the resistance or friction of such apparatus. The motion is transmitted to the fan-wheel from the driving pulley through the tubular shaft, running loose on the transverse shaft, and to the internal toothed spur-wheel, which imparts a rotatory motion to the transverse shaft through the spur pinions, and the rotation of this shaft is transmitted to the fan-wheel by the bevil-wheel and pinion hereinbefore referred to.

The fan-wheel is made heavy to act as a species of fly-wheel, and the disc to which the bevil-wheel is secured is also made heavy for a similar purpose, by which means the transverse shaft will always tend to rotate at an even and regular speed; but when the speed of the engine increases, the tubular shaft and internal toothed spur-wheel will overrun the small pinion fast on the transverse shaft, and the pinions which run loose on the lever will consequently mount up the side of the central pinion, and alter the position of the lever, the same effect, but reversed, taking place when the motion of the prime mover becomes too slow.

I have represented in the accompanying diagrams a regulator, the blades of which turn in a liquid, such as water, oil, &c. As the density of liquids is much greater than that of air, and as consequently a much greater resistance is offered to the fan, I give them a very much smaller area than those for the regulators wherein the resistance of the air alone is used. The various arrangements for obtaining the different movements required are represented in detail.

The frame supporting the apparatus is simply composed of a circular box of cast-iron, A. Inside this box are placed the fixed blades or partial partitions, *a*, a small clearance being left to allow of the passage of the circular disc or fan-wheel, B, to which are fixed the blades, *b*. The advantage of this disc is that it acts as a fly-wheel, and regulates the movements of the blades in the liquid. The cover, C, is cast in one piece with the socket, *c*, and arched support, c^1. This arch serves to maintain the vertical shaft, D, in its proper position; it may, if necessary, be replaced by a footstep placed at the bottom of the box, A. The cover is fixed to the box by means of the screws, *d*, and is hollowed internally at *e* to receive the liquid, which is increased in volume when the fly-wheel, B, heats it by its rapid rotation. An aperture, E, serves to introduce the liquid. On this cover are fixed the two supports, F, in which the horizontal shaft, G, turns, and the socket, H, on which is keyed the pulley, H^1, which receives motion from the prime mover, and transmits it to the various wheels which produce the movements required for the regulation of the prime mover. This movement, which can be obtained by various methods, as I am about to describe, consists of a wheel, I, toothed on the inside and fixed to the tubular shaft or collar, H. This wheel gears with the two pinions, J, mounted on studs in the lever, J^1, the centre of which is traversed by the shaft, G. These two pinions gear in their turn with the pinion, K, fixed upon the horizontal shaft, G. On this same shaft is mounted the bevil wheel, L, connected with the disc, *l*, which forms a fly-wheel. This wheel drives the pinion, M, fixed upon the vertical shaft, D, which carries the fan and fly-wheel, B. The lever, J^1, is put into communication either with the sluice of a water-wheel or with the throttle-valve of a steam-engine, and is furnished with a weight, P, at its extremity, sufficiently heavy either to raise the sluice or turn the valve, and transmit motion through the pulley, H^1, to the fan-blades, *b*.

Supposing this apparatus to be in communication with a prime mover which drives the pulley, H, at a velocity of 100 revolutions per minute, this motion is transmitted through the apparatus to the fans, *b*. At this velocity the fans produce against the air or the water, according to which element is used, a resistance equal to the force exercised by the weight, P. If, for example, this weight weighs about 20 lbs., the resistance of the water added to the friction produced by the various parts of the apparatus will equalise or balance the weight. The motion is thus re-established in the pinion, K, which transmits the motion to the fans by the aid of the bevil-wheel, L.

The lever maintains its horizontal position so long as the fans driven by the prime mover revolve at the proper velocity; but if, through the speed of the prime mover being improperly increased, the wheel, I, has a greater velocity given to it than the pinion, K, the speed of which is invariable, there results a differential movement of the pinions, J, which produces a corresponding movement in the lever, J^1, which, by acting upon the sluice or valve, diminishes the speed of the prime mover. If, on the contrary, the prime mover is going at too low a speed, the speed of the wheel, I, is, by a reverse of the motions, previously explained, diminished, and acting upon the lever in a reverse direction, produces a differential movement in the opposite direction to the one described in the previous case, and opens the valve, admitting more steam to the engine.

AMERICAN NOTES, 1856.—No. IV.

STEAM NAVIGATION.

Collins' Line.—The *Adriatic*, the new steamer for this line, built to supply the place of the *Arctic*, will be launched on or about the 20th inst. (March), and will be pushed to a completion, so as to make her first trip in the month of August next.

Her dimensions and particulars (for the first time published) are as follows:—

Built by James and George Steers; Engines by Novelty Iron Works, New York.

Length on deck	350 ft. 0 ins.
Breadth of beam (moulded)	49 „ 0 „
Do. do.	50 „ 0 „
Depth of hold	25 „ 0 „
Depth of hold to spar deck	33 „ 2 „
Hull / Engine-room } Carpenter's measurement	5,888 tons.

Kind of engines, oscillating; vertical tube boilers; diameter of cylinders, 100 in.; length of stroke, 12 ft.; diameter of paddle-wheels over boards, 40 ft.; length of boards, 12 ft.; depth of ditto, 3 ft.; number of ditto, 32; number of boilers, 8; area of immersed section at load draught, 740 ft.; draught forward, 20 ft.; ditto aft, 20 ft.; frames, moulded, 22 in., sided, 13 and 16 in., and 33 and 36 in. apart; independent steam, fire, and bilge pumps, 2; intended service, New York to Liverpool.

Remarks.—Hull strapped with diagonal and double-laid iron braces, $5 \times \frac{7}{8}$ in.

Further particulars will be furnished at an early date.

From these elements, and those before furnished by me, it appears that the *Persia*, *Adriatic*, and *Vanderbilt*, representing the latest essays of the three rival lines—the Cunard, Collins, and Vanderbilt—have the following differences in the elements essential to speed and burthen:—

	Persia. Ft.	in.	*Adriatic.* Ft.	in.	*Vanderbilt.* Ft.	in.
Length on deck	390	0	350	0	331	0
Beam	45	0	50	0	48	5
Hold	30	0	33	2	32	6
Draught of water at load line	23	0	20	6	19	0
Diameter of cylinders	100		100		90	
Stroke of piston	10	0	12	0	12	0
Diameter of wheels	40	0	40	0	41	0
Area of blade surface in one wheel.	896	0	1,072	0	720	0

If any of your correspondents will furnish the immersed section and dip of wheel at a given draught of water, and the grate and heating surface of the boilers of the *Persia*, I will furnish like particulars for the *Adriatic* and *Vanderbilt*, and thus complete this table of comparison.

At a subsequent period I will furnish the further elements of pressures, points of cutting off, revolutions, &c., of both the *Vanderbilt* and *Adriatic.*

New Lines of Steamers, in addition to the nine existing lines of steamers between Europe and the United States—viz: the Cunard (one each New York and Boston), Collins, Bremen, Havre, Vanderbilt, Antwerp, Glasgow and New York, and Glasgow and Philadelphia, we are to have four others—viz., a French line from Havre to New York, to commence running on the 20th inst.; a line from London to New York *viâ* Cork, to commence on the 1st proximo; a second Vanderbilt line, running from Liverpool to New York; and a Canadian line from Liverpool to Montreal, Portland, Boston, and New York.

Steam Frigate Niagara.—This vessel was launched on the 23rd ultimo. In addition to the particulars furnished you in your last Number, I give the following:—

Complement of men, 400.

	Length. Feet.	Diam. In.	Yards. Length. Feet.	Yards. Diam. In.
Mainmast	111·00	37½	101·00	24
Maintop	67·08	21	76·11	19¼
Main-topgallant	35·04	12½	51·03	11½
Main-royal	23·07	8¼	32·09	8
Main-skysail	14·06	6	21·00	5¾
Foremast	101·00	35	90·09	22
Foretop	59·00	20¼	67·09	16⅞
Fore-topgallant	31·10	11¾	47·03	11
Fore-royal	21·06	7½	31·09	7½
Fore-skysail	13·03	5⅜	19·06	5¾
Mizenmast	85·09	32	72·10	15½
Mizentop	50·04	15	51·03	11½
Mizen-topgallant	27·09	8⅞	34·10	8
Mizen-royal	18·00	—	22·03	6
Mizen-skysail	11·04	—	15·11	4¼
Swinging-boom	62·00	11½	35·00	8
Maintop-studdingsail-boom	55·00	11	31·00	7
Main-topgallant do. do.	41·00	8¾	23·00	5½
Main-royal do. do.	28·00	5⅝	17·00	4
Bowsprit, outboard	20·00	24	—	—
Jib-boom	38·00	13	—	—
Flying-jib-boom	33·00	—	—	—
Spanker-boom	67·00	15	—	—
Spanker-gaff	43·00	10¼	—	—
Main-spanker-gaff	42·08	9¼	—	—
Fore-spanker-gaff	41·03	9	—	—
Not enumerated	49·06	—	11·00	—
Total	1,190·03		854·00	

Making a total of 2,044 feet and 3 inches as the whole length of the masts and spars to be used in sailing the vessel. The mainmast, from the keel to the flag-pole, will be 200 feet high.

The following materials—exclusive of armament and machinery—have been used in her construction:—

Live oak timber, cubic feet	40,000
White oak timber, cubic feet	10,000
White plank, superficial feet	11,000
Yellow pine timber, cubic feet	42,000
Yellow pine plank, superficial feet	60,000
White pine timber, cubic feet	3,000
White pine plank, superficial feet	42,000
Iron	350,000 lbs.
Copper	140,000 „
Spikes	20,000 „

New Granada Canal Steam Navigation Company.—This Company are about adding to their line a new steamboat, the *James A. Requa*, which will leave here this month for Carthagena.

She is the second that has been furnished to this Company, and it is proposed to commence the construction of a third at a very early date.

The design of this vessel is so well adapted for its peculiar service, that I give you her particulars, a review of which will render manifest that she combines the indispensable qualities of burthen, extremely light draught of water, accommodations for passengers, and speed.

Built by Haslan and Hollingsworth, of Wilmington, Delaware.

Length over all	217 ft. 6 ins.
Length on deck	214 „ 0 „
Length between perpendiculars	210 „ 0 „
Breadth of beam	32 „ 0 „
Depth of hold	7 „ 0 „
Hull, Engine-room	450 tons.

Kind of engines, inclined direct non-condensing; ditto boilers, cylindrical flued; diameter of cylinders, 24 in.; length of stroke, 8 ft; diameter of paddle-wheels over boards, 26 ft.; length of boards, 8 ft.; depth of ditto, 1 ft. 3 in.; number of ditto, 19 ft.; number of boilers, 5; length of ditto, 35 ft.; breadth of ditto, 3 ft. 6 in.; number of furnaces, 5; breadth of ditto (total), 18 ft. 6 in.; length of fire-bars, 6 ft.; number of flues, 10; internal diameter of ditto, 1 ft. 3 in.; length of ditto, 34 ft.; diameter of chimney, 5 ft.; height of ditto, 50 ft. 9 in.; area of immersed section at load-draught, 70 ft.; load on safety-valve in lbs. per square inch, 140; heating surface, 2,400 ft.; load-draught, 2 ft. 6 in.; weight of engines and wheels, 210,000 lbs.; ditto boilers, without water, 120,000 lbs.; frames, shape L, 3 in. × 3 in. × $\frac{3}{8}$ in., and 24 in. apart; number of strakes of plates from keel to gunwale, 11; thickness of plates, $\frac{3}{8}$, $\frac{5}{16}$, and $\frac{1}{4}$ in.; number of bulkheads, 3; diameter of rivets, $\frac{5}{8}$ in.; distances apart, 2 in., single rivetted; depth of keel, 4 in.; independent steam, fire, and bilge pumps, 1; intended service, New Granada. Remarks: has 11 athwartship-frames, and 8 side keelsons, 12 in. deep.

The following letter refers to subjects of much importance connected with steam navigation, and is of especial interest to your countrymen, who so tenaciously adhere to the system of steering steamers from aft:—

Board of Underwriters,
New York, February 11th, 1856.

Dear Sir,—In consideration of the peril incurred and injury sustained by the steamer *Persia*, upon her late trip from Liverpool here, I beg leave to renew my suggestion of a previous date, regarding the manner of steering steamers, wherein I recommended that the owners of all steamers be required to have them steered forward instead of aft, as is customary in our Atlantic lines, and, at the same time, to invite your attention to the subject of athwartship bulkheads.

In order to present this subject of steering to you in as brief a manner as practicable, I submit the following summary of the elements of the case, and the advantages of such a change:—

When a steamer is steered aft, there is required, in addition to the officer of the watch, a second officer to be stationed aft to communicate orders to the helmsman; the duty of look out being confided alone to the forecastle watch, and to the officer of the watch.

When the wheel is placed forward the number of look-outs is increased by the addition of the second officer of the watch and the helmsman.

When an observation forward renders necessary immediate action with the wheel, the order is given from the forecastle to the officer of the watch, by him it is repeated to the officer of the wheel, and by him to the wheel: this course, involving both a delay and ambiguity of interpretation that has in many cases proved fatal.

Regarding the construction and use of athwartship bulkheads, it is unnecessary for me to enter into any details, as the subject is one fully understood by you, so that all that is left for me to do is to suggest that you adopt some course whereby an inducement is held out to the owners of steamers to fit their vessels with them. The example of a resort to them has been set in nearly all of the foreign iron steamers, and in two of the New York and Havre line; and I am gratified in being able to advise you, that upon an interview just had with E. K. Collins, Esq., he promptly declared his intention to have all the steamers of his line forthwith fitted with them.

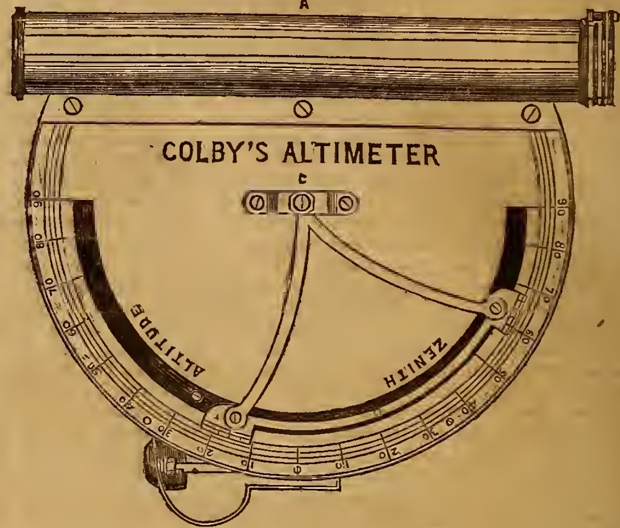
The frequency of an obscured atmosphere, arising from fogs and snow storms, and the presence of icebergs and ice upon the principal steamer route, viz., between this and England, and the great number of vessels traversing it, added to the character of the entire coast upon both sides, renders this route the most perilous of any open to navigation.

In view, then, of the existing dangers of this route, about to be increased by the addition of no less than five lines of steamers, I am of the opinion that your interests, aside from the dictates of humanity, render it imperative that prompt action should be taken regarding the change proposed in steering, and the adaptation of bulkheads enclosing the vessel into compartments.

I am, respectfully,
Your obedient servant,
Chas. H. Haswell, Surveyor.

A. B. Neilson, Esq.,
Prest Board of Underwriters,
New York.

Colby's Altimeter.—This is the name given to a new nautical instrument for determining latitude at sea when the horizon is obscured by fog, haze, or mirage. Also, by which calculations for dip, refraction, and parallax, are entirely avoided. The instrument has been tested for some months, and has high testimonials from those who have used it.



The following are the recommendations of Capt. Comstock, of the Collins' line, and Lieut. Boggs, U.S.N.:—

New York, September 15th, 1854.

Dear Sir,—From a careful examination of your altimeter I am convinced of its great usefulness, and from the fact of its containing within itself a zenith and horizon, thereby compensating for semi-diameter, dip, refraction, parallax, &c., makes it the most useful invention I have ever seen.

In regard to the state of the atmosphere being necessary—as the natural horizon is not used—the fogs and haze, so often preventing observations, cannot with this instrument interfere.

Many years' experience with your compasses has given me great confidence in your knowledge and ability to correct the local attraction, and I think a more general attention to the correction of compasses would be highly useful, and, probably, save many lives and much property.

Very truly yours, &c.,
Joseph J. Comstock.

Hall Colby, Esq., New York.

New York, November 15th, 1855.

Dear Sir,—I have had many opportunities for using your instrument, and have as great confidence in it as ever, and in no wise have changed my opinion in regard to it.

Yours respectfully,
Joseph J. Comstock.

Hall Colby, Esq., New York.

New York, January 19th, 1856.

Hall Colby,—I have used your altimeter for taking altitudes, for finding latitudes, &c., and have tested its accuracy in still weather. The importance of the altimeter consists in requiring no horizon, and can be used in fogs, &c. I consider it invaluable to shipowners and commanders. I should be unwilling to go to sea without it. I can recommend it, with confidence, to all interested in nautical science and connected with nautical matters.

In connexion with the altimeter I would also call the attention of navigators and others to your valuable astronomical engravings, and your new method of disposing of altitude, zenith, and declination.

Yours, &c.,
Charles S. Boggs, Commander, U.S.N.

I regret my inability to give you a more perfect drawing of it; but with the knowledge of known means and appliances, one cannot fail to understand the following sketch as fully as necessary:—

A is an ordinary telescope, to which is attached a hollow semi-cylinder, having on one side a suitable handle whereby the instrument is held by the left hand in the required position, and on the other a graduated arc; within this semi-cylinder is a heavily loaded pendant, suspended at the centre, C, and upon the lower periphery of it is a trigger pawl.

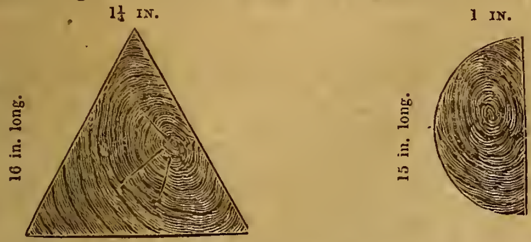
The manner of operation is as follows:—The observer, holding the instrument by his left hand, with the thumb and fore finger of his right hand upon the trigger, raises the telescope to his eye in the direction of the sun, and when he observes it he disengages the trigger, which pawls the pendant in the position it has gravitated to, and which is in a plane vertical to the horizon. The angle of elevation of the sun is then read off from the graduated one, and the operation is complete.

A joint-stock company has been formed here to work this patent, and the market is already supplied with them.

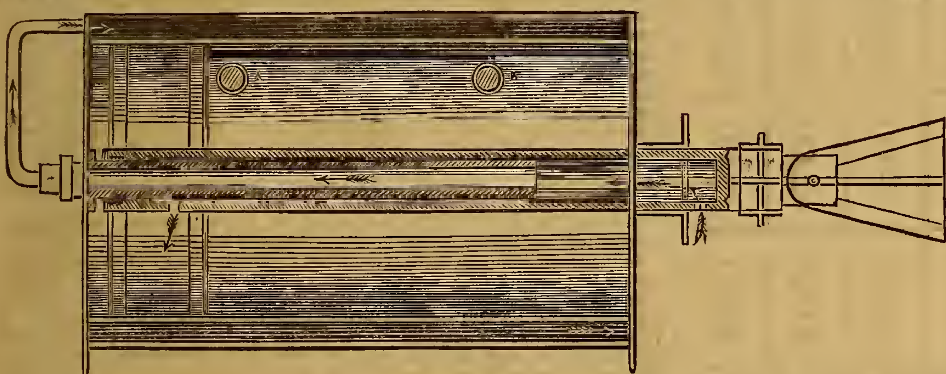
MISCELLANEOUS.

Sibley's Emery Sticks.—This is a new article of manufacture here, which has won itself into favour. The manufacturer furnishes twenty-eight sizes and shapes of "sticks" of a variety of figures, suited to the wants of a finisher of metals, having the convenience of form of a file and handle, and coated with emery of four different grades.

The following are sections of two of the sticks:—



The New Motor of Dr. Drake, late at the Crystal Palace, consists of an ordinary high-pressure steam-cylinder 16 in. diameter, with a piston having 18 in. stroke, connected with a crank axle on which there is a heavy fly-wheel.



It is without furnace, boiler, or chimney, and has simply an atmospheric air, a gas, and exhaust pipe connected with the cylinder.

I give from the inventor's pamphlet the following description:—

"It is well known that certain gases and vapours, when mixed with definite proportions of atmospheric air, form inflammable compounds, which burn rapidly or explosively when fired, the heat evolved occasioning a large increase of bulk, or an expansion.

"When a mixture of one part of coal or illuminating gas with nine or ten times its bulk of atmospheric air is confined, as in the cylinder of an engine, and then ignited, a great pressure is exerted by the expanded products of the combustion in every direction, and the piston of the engine, being moveable, is impelled forward, giving motion to such machinery as may be connected with it.

"This is the power which actuates the *ignition engine*, which may be described in fact as an air engine, using fuel in a gaseous form in its cylinder, and dispensing with a separate heater, furnace, smoke-pipe, &c.

"Upon firing the mixture as named, an expansion is produced equal to a pressure of one hundred and fifty pounds, or upwards, upon every square inch of surface; and the products of the combustion when cooled being nearly equal in quantity as before, demonstrates that the great increase in bulk is due solely to the heat evolved by their rapid combination.

"In the construction, the general arrangements of the steam-engine are made use of, the valves being so placed as to tighten under the pressure within the cylinder: the induction valves closing on the admission of an adequate supply of the explosive mixture at a determined point.

"After the charge is taken into the cylinder, and the induction valve closed, the continual travel of the piston uncovers an opening communicating with the *ignition* apparatus.

"In order to insure a mixture of gas and air in proper proportions, a regulating valve, to both the supply pipe of the engine and the ignition supply pump, is arranged so as to cover an opening to the gas-pipe, and also a much larger opening to the atmosphere. The gas-pipes have cocks which are adjusted so as to admit a definite supply of gas; for instance, one volume of the ordinary bicarburetted hydrogen gas—such as is used for illumination—requires for its perfect combustion about nine volumes of atmospheric air. And if a cock is adjusted so as to admit only one-tenth of the joint capacity of the openings under the valve, a mixture is obtained which will produce the greatest heat and consequently the most power.

"The power of the engine may be regulated by a throttle-valve in the supplying gas-pipe controlled by a governor.

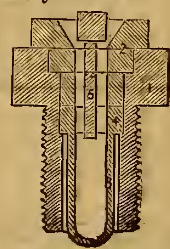
"To start the engine, it is necessary to have the reservoir charged to heat the igniters, and that the piston of the engine should be past one of the openings of the same.

"The first motion is given by passing into the cylinder, through a connexion for the purpose, a portion of explosive mixture from the reservoir; this is instantly fired by the igniter and impels the piston, which in its travel draws in regular supplies, and a reciprocating action is maintained.

"In order to prevent an injurious accumulation of heat and to produce lubrication, cold water from any convenient source is circulated through and around the engine, by means of a jacket or casing surrounding the cylinder, and by having the piston-rod hollow, as a tube, through which water passes into the hollow body of the piston, and thence by means of a metal tube playing through a stuffing-box in the end of the piston-rod, by proper connexions, into the jacket around the cylinder, and finally carried off through a waste pipe."

The distinguishing feature of the machine consists of a hollow thimble-shaped piece of cast-iron, two or three inches in length, by about one nch internal diameter, and one-eighth of an inch thick, placed upon and utting through the cylinder towards either end, at the point where it is ntended to fire the charge of gas and air.

The top of the igniter is open to admit the blow-pipe, which is also of cast-iron, and through which a portion of the explosive mixture under pressure is discharged and burned, heating the thin shell of the igniter with intensity, instantly and effectively firing the mixture so soon as the piston passes the red point, and brings the mixture in contact with it.



The engraving represents a section of the cylinder, showing the ends of the igniters, *a* and *b*, and the circulation of the water for cooling the cylinder and piston, as shown by the arrows, and also a detached sectional view of the igniter, showing its different parts. H.

ON THE COMMERCIAL ECONOMY OF WORKING STEAM EXPANSIVELY IN MARINE ENGINES.*

By Mr. Edward E. Allen, of London.

(Continued from page 41.)

Table XXIII.—Section B.

Table showing the Spaces *occupied by engines, boilers, and passages together, and by coals; and also the ratio of the Total Spaces; the total pressure increasing from 35 to 60, 80, 100, and 120 lbs. per sq. in.; the size or nominal* H.P. *of the engines, the indicated* H.P., *and the total space occupied by machinery remaining the same.*

Class.	Service.	Total pressure of steam in lbs. per sq. in.	Space occupied by engines, boilers, and passages constant.	Ratio of spaces occupied by coals.	Ratio of total spaces.
1	River.	35	3	1·00	4·00
		60	3	·53	3·53
		80	3	·43	3·43
		100	3	·38	3·38
		120	3	·35	3·35
2 and 3	Coasting and Continental, and Ocean (short voyages).	35	3	3·00	6·00
		60	3	1·59	4·59
		80	3	1·29	4·29
		100	3	1·14	4·14
		120	3	1·05	4·05
4 and 5	Ocean (long voyages), and voyage out and home.	35	3	5·00	8·00
		60	3	2·65	5·65
		80	3	2·15	5·15
		100	3	1·90	4·90
		120	3	1·75	4·75

* Paper read before the Institution of Mechanical Engineers, Birmingham, July 25, 1855.

Sections A. and B. show how the total weights of machinery and coals taken together, and also the total spaces occupied by them, decrease from Class 1 to 5, owing to a saving of coals alone. No advantage has been taken of the decrease in the space required for the boilers, although much less fuel is used; because high-pressure boilers usually occupy more space, for the same power, than low-pressure boilers.

TABLE XXIII.—SECTION C.

Table showing the Gain in CARGO SPACE, *when the space occupied by the engines, boilers, and passages is constant; the total pressure increasing from* 35 *to* 60, 80, 100, *and* 120 *lbs. per sq. in.; the size or nominal* H.P. *of the engines, and the indicated* H.P. *remaining the same.*

Class.	Service.	Total pressure of steam in lbs. per sq. in.	Ratio of total spaces occupied by machinery and coals, from foregoing table.	The same ratio, but showing the per-centage decrease.	Per-centage gain in cargo-space. 1st. When total machinery and coal-space is *equal* to total cargo-space.	2nd. When total machinery and coal-space is 2-3rds of total cargo-space.	3rd. When total machinery and coal-space is *half* of total cargo-space.
					Per cent.	Per cent.	Per cent.
1	River.	35	4·00	100	—	—	—
		60	3·53	88	12	8	6
		80	3·43	86	14	9⅓	7
		100	3·38	84	16	10⅔	8
		120	3·35	83	17	11⅓	8½
2 and 3	Coasting and Continental, and Ocean (short voyages).	35	6·00	100	—	—	—
		60	4·59	76	24	16	12
		80	4·29	71	29	19⅓	14½
		100	4·14	69	31	20⅔	15½
		120	4·05	67	33	22	16½
4 and 5	Ocean (long voyages), and voyage out and home.	35	8·00	100	—	—	—
		60	5·65	71	29	19⅓	14½
		80	5·15	64	36	24	18
		100	4·90	61	39	26	19½
		120	4·75	59	41	27⅓	20½

Section C. shows how the cargo-space continually increases from Class 1 to 5. The last section of Table XXIII. gives a general summary of the three preceding ones.

It will render the results of these tables more easily understood, to trace them out with reference to one of the five classes of steamers, and as one of the most important, Class 4, or the Australian vessels, may be taken. From Table I. it will be seen that the quantity of coal usually taken is equal to about four times the gross weight of machinery, and that this quantity lasts about forty days, that is, with 35 lbs. steam, cut off at 3-4ths of the stroke. From Table VIII. it will also be seen that the quantity of coal annually consumed, if the vessels be kept at work, amounts to 25 per cent. of the cost of the vessels or capital.

Upon referring to Section D., Table XXII., it appears that if the cylinders be doubled in capacity, to allow of more expansive working, the coal required for the same time and to develop the same power is so far reduced, that 7¼ per cent. per annum is saved on the original capital; and that if the weight of coals carried be kept the same, they will last fifty-six days instead of forty. Also, if the cylinders be increased in capacity to three times, the annual saving in coal will amount to 10¾ per cent. on the original capital; and if the same weight of coals be carried, they will last seventy days instead of forty.

Referring now to Section D., Table XXIII., it appears that by using steam of 80 lbs. pressure instead of 35 lbs., the annual saving in coal will amount to 14¼ per cent. of the original capital; and that the same quantity of coals will last ninety-three days instead of forty. Also, if the pressure be increased to 120 lbs., the annual saving in coal will amount to 16¼ per cent. on the original capital; and the same quantity of coals will last 114 days instead of 40.

Again, if instead of carrying coals for an additional number of days, the space they would occupy be appropriated to cargo, then, by the central columns, on the supposition that the total machinery and coal-space is equal to 2-3rds of the total cargo-space, the latter will be increased 12 and 18 per cent. when the size of the engines is increased to two and three times respectively, and 24 and 27⅓ per cent. when the pressure is increased to 80 and 120 lbs. respectively. By the last columns of Section D. it will be seen, that, on the same supposition, and supposing the net profits for two years to be equal to the cost of the vessel, that is, the receipts on the cargo-space to be 50 per cent. of the original capital, then the total annual gain from saving in coals and increase of cargo-space will be 13¼ and 19¾ per cent. of the original capital, when the size of the engines is increased to two and three times respectively, and 26¼ and nearly 30 per cent. when the pressure is increased to 80 and 120 lbs. respectively.

These results are of the highest importance, and well deserve the consideration of those embarking capital in undertakings of this nature.

In concluding this examination of the beneficial effects of expansion, the author may remark that there are various aspects and suppositions under which they might be demonstrated, and few can be more fully aware than himself of the imperfections which may be found in these contributions to the subject. It is difficult to present a comprehensive view of the subject in an abstract form; but perhaps enough has been done to serve as a ground-work upon which calculations suited to specific cases can be based; this may be done by substituting the correct quantities in any particular case for those given in the Tables.

TABLE XXIII.—SECTION D. GENERAL SUMMARY.

Table compiled from the three foregoing Tables; the cost, weight, and space of engines, boilers and passages, and water, being constant; the pressure increasing from 35 *to* 80, *and* 120 *lbs. (the intermediate pressures being omitted), the size or nominal* H.P. *of the engines, and the indicated* H.P. *remaining the same.*

Class	Service.	Total pressure of steam in lbs. per sq. in.	Annual saving of coal in per-centage of capital (Table XVIII).	Increase of capital per cent.	Total weight of coal and machinery; decrease per cent. (deduced from column 6, section A).	Total spaces occupied by coal and machinery; decrease per cent. (deduced from column 6, section B).	Cargo-space: increase per cent. When total machinery and coal-space is *equal* to total cargo-space.	When total machinery and coal-space is 2-3rds of total cargo-space.	When total machinery and coal-space is *half* of total cargo-space.	Per-centage of increase of time the coals would last, if total weights be kept the same.	Number of days the coals would last, if total weights be kept the same.	Annual per-centage gain on capital from saving of coal and increase of cargo-space. If the net profits cover cost of vessel in one year.	If the net profits cover cost of vessel in two years.
					Per cent.		Per cent.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.
1	River.	35	—	Capital constant; the same engines and boilers, &c., being used in all cases.	—	—	—	—	—	—	2½	—	—
		80	8·55		11·00	14	14	9⅓	7	132	5¾	17·88	13·21
		120	9·75		13·00	17	17	11⅓	8½	185	7	21·08	15·41
2	Coasting and Continental.	35	—		—	—	—	—	—	—	10	—	—
		80	2·85		28·50	29	29	19⅓	14½	132	23	22·18	12·51
		120	3·25		32·50	33	33	22	16½	185	28	25·25	14·25
3	Ocean (short voyages) and Government.	35	—		—	—	—	—	—	—	15	—	—
		80	2·85		34·00	29	29	19⅓	14½	132	35	22·18	12·51
		120	3·25		39·00	33	33	22	16½	185	42¾	25·25	14·25
4	Ocean (long voyages) Australian.	35	—		—	—	—	—	—	—	40	—	—
		80	14·25		45·60	36	36	24	18	132	93	38·25	26·25
		120	16·25		52·00	41	41	27⅓	20½	185	114	43·58	29·91
5	Ocean (voyage out and home).	35	—		—	—	—	—	—	—	70	—	—
		80	2·85		49·87	36	36	24	18	132	162	26·85	14·85
		120	3·25		56·87	41	41	27⅓	20½	185	200	30·58	16·91

In the former paper the author made a deduction from the annual saving in coal for the interest on the extra capital required for larger engines of the ordinary construction; but no provision was made for the repayment of such extra capital. This might be rendered more simple by supposing the gain from saving in coals and increased cargo-space to be set aside until the extra capital was repaid. This would be done in a few years, according to the ratio which the annual profits bore to the capital. After the repayment of the extra capital the annual gain would be constant, and no reduction would have to be made for interest, the profits resulting from saving of coal and increase in cargo-space.

The author will now refer to the advantages contemplated in the new forms of engines proposed in the former paper, which are as follows:—

1st. That the steam on its entrance to the cylinder, acting on a comparatively small area, would admit of the pressure being considerably increased, without the weight of the engine being increased to anything like the extent necessary in the case of a common cylinder of large area.

2nd. That in order to work expansively, it would not be necessary to increase the length of the cylinder or stroke of the engine, which would be the case with an ordinary engine: the double expansion rendering the length of cylinder virtually double.

3rd. That the arrangements proposed possess all the advantages of compactness obtained by the use of a trunk, thus conveniently allowing of a longer connecting-rod than would be possible in any other way in the same space.

4th. That upon either of the plans represented in Plate 17 (see Proceedings, April, 1855,) the power of the engines could be almost indefinitely increased, not only by using steam of higher pressure, but also by increasing the *diameter* of the large cylinder; retaining a short stroke for the sake of getting sufficient speed for a screw-engine.

5th. That the floor-space required for the engines, on these plans, would not exceed from 1-4th to one-half of a sq. ft. per nominal H.P., or about half the space usually occupied by other direct-acting engines; the pressure and degree of expansion being supposed to be in both cases the same.

6th. That the space required for the engines, so as to obtain a greater degree of expansion than usual (greater capacity of cylinder under whatever form or arrangement being of course necessary), would not increase in a higher ratio than that in which the space occupied by the boilers would decrease, less steam being required for the same power; so that the total spaces would remain constant for almost any degree of expansion.

7th. That the steam from its entrance to its exit would work against a vacuum.

8th. That the difference of pressure at the beginning and end of the stroke would be very considerably less than in an ordinary engine expanding to the same degree. For example: suppose an ordinary single cylinder, with steam at 45 lbs. expanding nine times, or to 5 lbs.; then, deducting the back pressure, say 3 lbs., we have 45 — 3 = 42 lbs. at the beginning, and 5 — 3 = 2 lbs. at the end of the stroke, being in the ratio of 21 to 1. If the expansion take place in two stages, as in the arrangements proposed, then for the first stage we have 45 — 3 = 42 lbs. at the beginning, and 15 — 3 = 12 lbs. at the end of the stroke, being in the ratio of $3\frac{1}{2}$ to 1 only; and for the second stage (taking place in the opposite cylinder), we have 15 — 3 = 12 lbs., and 5 — 3 = 2 lbs., being in the ratio of 6 to 1 only. The mean total difference is only $4\frac{3}{4}$ to 1, and this for the same degree of expansion of 9 times.

9th. That the combination of the trunks not only counteracts the atmospheric pressure on the outer ends of them, which would prevent much expansion, but also saves the second connecting-rod, and further serves the purpose of guides, and prevents the work of the connecting-rod being thrown too severely on the trunk and stuffing-box. The combination of the trunks also renders the work done by the out and in strokes (of a horizontal engine) quite equal; the high-pressure steam of one cylinder always acting in conjunction with the low-pressure steam of the opposite cylinder. This equality of work in the in and out strokes cannot well be obtained with a single trunk, except it be carried through the cylinder, as in Messrs. Penn's engine. The only way in which it is ordinarily attempted is by cutting off the steam later on the trunk side of the piston, by giving the valve less lap on that side. This method of obtaining uniformity is obviously very limited, and not compatible with high degrees of expansion.

10th. That owing to the strength of the various parts of the engine being determined by the pressure of the steam on its first entrance into the cylinder, and this taking place on a comparatively small area, the cost and weight of engines would not increase as on the ordinary construction; and it is presumed that the reduction in the cost of boilers, owing to less steam being required for the same power, would cover any extra cost of engines arising from the greater capacity of cylinder, which is required in order to work more expansively than usual.

Mr. Allen explained the drawings of his engine, and the mode of its action. He stated that his view had been principally to obtain compactness and sufficient uniformity in the power, combined with a much higher degree of expansion than was at present used in marine engines. There were many practical difficulties in the more extended application of the expansive principle in those engines, on account particularly of the very confined space available for them in the vessels.

The Chairman inquired whether the calculations in the paper had been made only theoretically; he supposed no actual trial of the engine upon the new arrangements proposed had yet taken place.

Mr. Allen explained that the calculations had not been made from actual indicator diagrams, as there had not been an opportunity at present of making a trial of an engine on the proposed plan; but he had made the calculations from carefully constructed diagrams, based on those obtained from the actual working of engines that were so far similar in their action, as to afford safe practical data for the calculations, and full allowance had been made for loss of temperature during expansion of the steam.

The Chairman observed that strong objections were generally entertained by marine engineers to the use of high-pressure steam for their engines; greatly on the ground, he believed, of priming, arising probably from the quantity of salt in sea water; but he did not see why these difficulties should not be surmounted.

Mr. Allen stated that in his original paper, which was read at the previous meeting, he had confined his attention to the case of low-pressure steam, 35 lbs. total pressure, or 20 lbs. above the atmosphere, as that was the general limit at present in marine engines; but in the present supplementary paper, he had extended the calculations given in the previous one to the case of high-pressure steam, in accordance with the desire expressed in the former discussion.

The Chairman inquired what means he proposed for getting over the difficulties which were met with when high-pressure steam was used?

Mr. Allen said that the object of his paper was not to investigate any special means of getting over the difficulties accompanying the use of high-pressure steam, but merely to show what advantages in point of economy would result, in case some effectual method of overcoming them could be devised.

Mr. Jones observed that facts obtained by actual trial were very essential for confirming theory on such a subject, which was one in which it would be important to have the calculations verified by practical experience; he considered that the calculations in Mr. Allen's paper threw much valuable light on the economy of expansion.

Mr. Hodge thought there would be much liability to error in basing calculations on theoretical tables only, not derived from experiments, and in adopting a new design of engine, like that brought forward in connexion with the paper, which had not yet been tried in practice. He disapproved of the short stroke of the engine proposed, since the total effect with the same expansion, that is, cutting off at the same fraction of the stroke, was not so good in a short stroke engine as in a long one; but he considered the use of the two cylinders an advantage, on account of the greater uniformity of motion thereby obtained; the latter, however, was not a point of such importance in the propulsion of vessels as in manufactories, since the momentum of the vessel was great, and not easily affected by irregularities in the stroke; but in driving machinery, all variations in the power given out at different portions of the stroke were detrimental. The arrangement of the trunks for shortening up the engine appeared very good, but he thought the cylinders were shorter than was advisable, because less power was obtained out of the steam by expanding the same volume of steam in a short cylinder than in a long one, as was shown by adding up the ordinates of the expansion curves.

The Chairman inquired whether the form of engines represented was expressly designed for high-pressure steam, or whether any other form would be considered preferable in that case.

Mr. Allen replied that the engines were not designed for very high-pressure steam, but only for pressures of about 35 to 45 lbs., including the atmosphere; the advantages contemplated in them were those arising from saving in cost and space occupied, and from allowing the expansion to be carried to a higher degree than usual; large trunks might be objectionable with very high pressure, as the effects of the difference in area would then be rendered more perceptible. The advantage of a long stroke was admitted, but it appeared to be impracticable to obtain a long stroke in a marine engine, with sufficient velocity of revolution of a screw shaft.

The Chairman inquired what was the velocity of revolution proposed with Mr. Allen's engines.

Mr. Allen contemplated working them up to 80 or even 100 revolutions per minute, which was about the speed required for screw shafts; this would give a speed of piston of about 300 ft. or 400 ft. per minute.

Mr. Hodge thought an engine might be driven at a considerably greater speed without difficulty; he had known 600 or 700 ft. per minute attained without difficulty in a long-stroke engine, and a good indicator diagram obtained at that speed.

The Chairman remarked that, independently of the difficulty of obtaining a long stroke with a great velocity of the shaft, the section of the vessel would not generally allow of a long stroke sufficiently low down for direct-acting horizontal cylinders.

Mr. Hodge said that the balancing of the cylinders by connecting the opposite trunks appeared to him to be a new and good arrangement; he had not seen it before, and it certainly made the engine very compact; but he did not see that it was accompanied by sufficient advantages to warrant complicating the engine so much as was done by the proposed arrangement.

Mr. Allen explained that it was not necessary to use four cylinders in order that the atmospheric pressure upon the open trunks might be balanced, as this could be done by working the opposite trunk in a condenser; by connecting the opposite trunks the effects of the variation of the pressure during expansion were diminished, and the atmospheric pressure was entirely neutralised; the four cylinders were, however, desirable where the expansion was carried down to the extent contemplated in the paper—namely, 5 lbs. above a vacuum, as the total power exerted in both directions was thus rendered quite equal. Without the trunk the same amount of expansion could not be obtained without having engines with a long stroke.

Mr. Hodge presumed the extent of expansion was limited only by the power required to overcome the friction of the engine.

Mr. Allen pointed out that the steam might be expanded with advantage to this limit in the engines he had proposed, as when the most expanded steam was acting on the large area of piston, there was, in addition to this, when the trunks were coupled, the steam at its highest pressure acting on the small area in the same direction.

Mr. Hodge thought that in horizontal direct-acting engines there was often a great error in not having sufficient length of bearing in the stuffing-boxes, and also in the pistons; it was proved in practice that there was no disadvantage in a long-bearing piston if well made. He considered that long-stroke single-cylinder engines were the most economical, and were preferable wherever that form was admissible.

The Chairman remarked that considerable economy was obtainable by a greater degree of expansion, even with the present pressure; but for carrying out the principle thoroughly it was essential to obtain a considerable increase of pressure, and he thought it was very important for an advance to be made in that direction.

Mr. Allen observed that doubling the size of the cylinders gave an economy of 29 per cent. with the same pressure as that generally used, 35 to 40 lbs. per inch, which would be a very important improvement on the present working. There were several practical objections to the use of higher pressures of steam, and he was not prepared to recommend much increase at present.

Mr. Hodge inquired what objections were generally advanced to the use of higher pressures; he did not know of any really serious objection, and thought the pressure might be much increased beyond the present average with important advantage in economy of power.

Mr. Allen said the objections were mainly those arising from minor points of detail, such as priming and leakage of stuffing-boxes and boiler joints; these were practical difficulties which might very possibly be got over with further experience.

The Chairman suggested that the general objection to high-pressure steam in marine engines was to be attributed to the circumstance of those connected with them not being so much accustomed to high-pressure steam; there did not appear to be any sufficient reason why it should not be used as much in marine as in land engines, and particularly in locomotives. He thought the difficulties met with in connexion with the boiler were such as ought to be got over, and would be set aside by engineers accustomed to construct high-pressure engines.

Mr. Hodge remarked that marine engineers in this country had mainly confined their attention at present to the low-pressure steam; but in the large American steamers on the Hudson condensing engines were worked with 70 lbs. steam, and a good vacuum of 28 in. was maintained without difficulty with that pressure. Of the difficulties which were urged priming, he believed, often arose from the steam-pipe from the boiler being too small in diameter; he had known cases where this had been the cause. The stuffing-boxes ought to give no trouble; they were always made steam-tight with high-pressure steam by the Cornish engineers, and in locomotive shops, and if not steam-tight in marine engines, the workmanship must be defective; he thought the difficulties that had been referred to were such as might be easily got over.

Mr. Allen observed that some difficulties might be treated as trivial in land engines, which became serious matters in the case of marine engines, from the difference in the circumstances; and in considering the extension of expansion in the latter class of engines, it was necessary to take account even of objections arising merely from minor points of detail. He anticipated that the first step towards improvement in marine engines would consist in using a higher degree of expansion with the present pressure of steam, and afterwards making trial of greater pressures. High-pressure steam had been very little tried yet in marine engines, and had always been found troublesome; he believed that some engines which had been originally constructed with high-pressure steam had been afterwards altered to low-pressure.

The Chairman observed that the gun-boats lately made for the Baltic fleet had steam of from 50 lbs. to 60 lbs. pressure, working without condensing, and he understood they answered very well, and a still higher pressure would probably be tried.

Mr. Shipton suggested that there might be some difficulty with the air-pumps shown in Mr. Allen's engine, from the speed and the position in which they were placed.

Mr. Allen remarked that such a difficulty would not affect the principle contained in his paper; any other form of air-pump might be adopted, if desired; but he did not think any difficulty was to be anticipated in working the air-pumps even at a higher speed than he had contemplated.

The Chairman said he had recently seen engines that had worked at 130 revolutions per minute in a vessel that had been out to Africa; the air-pumps had common leather butterfly valves, very well made, and no difficulty had been experienced from the high speed. He remarked that the great requisite for long voyages was sufficient surface in the working bearings to prevent any tendency to heating, in order to allow the vessel to continue running several days without stopping.

Mr. Shipton observed that the trunks shown in Mr. Allen's engine would increase the friction considerably; he inquired whether any account had been taken of the increased friction in the calculations of the paper.

Mr. Allen replied that the friction was not included in the calculations, in order that they might be as general as possible, instead of being limited to a particular form of engine; but he did not think it would materially interfere with the advantages of his proposed engine.

Mr. Shipton observed, that with the present construction of marine engines, the expansion, being performed in a single cylinder, must undoubtedly be more limited than in a compound cylinder such as had been proposed; otherwise a shock would be caused to the wheels or screw at each stroke by the great inequalities in the driving power; and, consequently, with a single cylinder, it was not advisable to cut off at a very early point in the stroke.

Mr. Allen said that no great degree of expansion could be obtained in marine engines, except by dividing the process into two steps, as in his proposed engine, by the use of double cylinders: it would be seen, by referring to the tables, that, with 120 lbs. steam, in order to expand down to the lowest useful pressure, in the present engines it would be necessary to cut off at 1-18th of the stroke, which was quite impracticable in a single cylinder, on account of the variation in pressure being much too great to be admissible in marine engines; it was only possible in such a case as the Cornish pumping engines, where great variation in power and velocity of piston was immaterial. But in his proposed engine this high degree of expansion could be obtained practically, by cutting off at 1-9th in the first cylinder and doubling the expansion in the second, or at 1-6th in the first cylinder and expanding three times in the second.

The Chairman inquired what degree of expansion was adopted in the large engines making at Soho for the great vessel of the Eastern Steam Navigation Company.

Mr. Garland said he believed it was not intended to work them very expansively, probably cutting off at about 1-3rd of the stroke; there were four cylinders, 84 in. diameter, with a 4-ft. stroke, and intended to work with about 25 lbs. steam above the atmosphere.

The Chairman suggested that, in many cases, the use of 100 lbs. steam without a condenser might be practically as economical as 50 lbs. steam with a condenser, and would have the advantage in simplicity and compactness.

Mr. Allen thought that condensing was preferable in all cases, and recommended the use of 40 lbs. to 50 lbs. or 60 lbs. steam rather than a higher pressure; the steam to be expanded down to 5 lbs. He showed by a table that when the expansion was carried down to 5 lbs. above a vacuum, there was practically very little margin left for further economy and the moving power was then very nearly counterbalanced by the friction and the back pressure of the condenser.

The Chairman remarked that their late member, Mr. W. Smith, of Dudley, had given a valuable contribution of actual results of the working of engines in the mining district, and he hoped some members would take up the subject in its different branches, to carry out the inquiry that had been so well commenced. The working results of the Cornish engines had been carefully attended to, and constant returns and comparative statements were prepared, with remarkable advantage to the owners, in the practical economy resulting from the plan; and there would doubtless be found greater advantage also in the extension of the plan to other classes of engines. His own conviction was that it would be necessary in many cases of marine engines, particularly in screw-steamers, to use a much higher pressure than was at present employed; the objections of engine-makers to attempting the use of high-pressure steam arose from the several practical difficulties that had then to be encountered, but he did not see any reason to doubt that these might be satisfactorily surmounted by further endeavours and improvements in construction or arrangement. The great importance to the employers of steam power of an extension of the expansive principle, in point of economy of power and increase in the cargo-space available in the vessels, had been strikingly shown in the able paper that had been read to the meeting. He expressed a hope that the views advanced in the paper might be carried out practically, and proposed a vote of thanks to Mr. Allen for his paper and tables, which was passed.

CORRESPONDENCE.

SCREW PROPELLERS.

To the Editor of The Artizan.

Sir,—The following may, perhaps, usefully accompany the Table of Speeds, &c., of screw propellers. (See pages 80, 81, of this Number.)

Ex. 1. Required the number of revolutions per minute the shaft of a screw of 14 ft. pitch must make, to give a speed to the screw propeller of 20 miles per hour. Refer to 14 ft. pitch and 20 miles, and at the intersection of the horizontal and vertical division there is 125·7, the number required.

Ex. 2. Required the speed in miles per hour of a screw, the pitch of which is 14 ft., and the number of revolutions per minute 125·7. On the horizontal line opposite 14 ft. pitch, refer to 125·7, and at the top of this division is 20 miles.

Ex. 3. Required the pitch of a screw which, making 125·7 revolutions per minute, shall give a speed of 20 miles per hour. Find, in the vertical division under 20 miles, the number 125·7, and trace thence to the side, where will be found 14 ft. pitch.

The speed of a screw propeller in miles or knots per hour, as given in the annexed Tables, is calculated upon the usual mode of supposing it to work in a solid; the difference between such speed in any given instance and the actual speed of the vessel being due to the much talked of "slip." Though the "slip" varies with different sorts of ships, and even with the same ship under different circumstances, it is yet frequently possible, in designing a vessel, to anticipate somewhat nearly, from experience with analogous vessels, the per-centage of slip that will occur in practice; and assuming such, it is then necessary to determine the speed the screw must make, in order to realise the desired speed of vessel. Thus, let the speed of vessel required be 16 miles per hour, and the anticipated positive slip be taken at 25 per cent., what must be the speed of screw?

Representing the speed of screw by x—

$$16 + \frac{x}{100 \div 25} = 16 + \frac{x}{4} = x$$

$$64 + x = 4x$$

$$64 = 3x$$

$$x = 64 \div 3 = 21·33 \text{ miles per hour.}$$

And, generally, if the speed of the vessel be a, and the per-centage of slip b—

$$a + \frac{x}{100 \div b} = x.$$

Also, by first dividing 100 by b (the per-centage of slip) and calling the result c, the formula may assume the shape of—

$$\frac{a\,c}{c-1} = x.$$

Adopting the previous question, first $100 \div 25 = 4 = c$, and then

$$\frac{16 \times 4}{4-1} = \frac{64}{3} = 21·33 \text{ miles as before.}$$

Suppose one other example—viz., the speed of vessel to be 14 miles per hour, and the slip 16 per cent., required the speed of screw.

Then, $100 \div 16 = 6{\cdot}25 = c$

And $\frac{14 \times 6{\cdot}25}{6{\cdot}25 - 1} = \frac{8.75}{5{\cdot}25} = 16{\cdot}66$ miles per hour.

To prove it, divide 16·66 by 6.25, and deduct the result from 16·66, the difference should be 14.

Thus, $16{\cdot}66 - 2{\cdot}66 = 14$ miles, as required.

Trusting the foregoing will, with the Tables, be useful to at least a few of the readers of your valuable journal,

I am, Sir, your obedient servant,

March, 1856. THOMAS T. COLLINS.

WORKING STEAM EXPANSIVELY.

To the Editor of The Artizan.

SIR,—In again looking over Mr. Allen's paper on the above subject, with all its tabulated matter, I hope Mr. Allen will believe me when I say that he deserves the best thanks of the profession for bringing this subject forward prominently for discussion, and also for the amount of time and thought which he must have expended in the preparation of so much important matter.

In a subject of so much importance I doubt not but Mr. Allen will expect from the profession varied and, it may be, opposing opinions. As, however, he has not only indicated the course such alterations as he proposes should take in the marine engine, but has actually embodied his proposals in a design for a pair of screw engines (See ARTIZAN, October, 1855, plate lvi.), in so doing he has put within the reach of all substantial means of judging of the practicability of his peculiar theory.

I hope he will also believe me when I assure him that in writing my last letter, which you were kind enough to insert in THE ARTIZAN, for December, it was with the simple object of drawing out still further Mr. Allen, and giving him an opportunity of explaining to me and others (*thickheads*) what had previously been, in his paper, rather dark and confused.

I now take this opportunity of thanking Mr. Allen for his courteous reply to my letter, which appeared in your last number; and respectfully ask of you to allow me through your pages to still further consider and discuss this important subject.

In entering on the discussion of such a subject, perhaps it would be both proper and profitable, the more easily to arrive at a mutual understanding, to lay down certain axioms on which we shall agree.

Axiom 1st. It is agreed that a well-proportioned boiler should evaporate, by 1 lb. of good Welsh coal, from 9 to 10 lbs. of water.

Axiom 2nd. In constructing a boiler the present measure of a nominal H.P. is as follows:—

Fire-bar surface, about $\frac{6}{10}$ sq. ft. per H.P.
Heating surface, „ $18\frac{1}{2}$ „ „

Axiom 3rd. It is also agreed that that marine engine which can fulfil the following conditions is the best—namely, extreme simplicity and fewness of working parts; lightness, combined with sufficient strength; and which will give out the highest indicated H.P. from a minimum quantity of coal.

Axiom 4th.—The indicator applied to the cylinder, and the following formula used:—

$$\frac{\text{Mean pressure} \times \text{speed of piston} \times \text{area of piston}}{33{,}000}$$

is the standard measure of power exerted in that cylinder.

A postulate may be added that, if I rightly understand Mr. Allen, his theory can be illustrated by taking any modern steam-engine, and by altering the engines only, he will allow the boilers to remain.

What I chiefly wanted to get at in my former communication was,—to what extent would Mr. Allen require the present engine enlarged? Also, the consumption of fuel by the present engine being 4 lbs. (Mr. Allen says 5 lbs. per indicated H.P., which shall be granted as a standard), what would be the cost in coal of Mr. Allen's engine per indicated H.P.? In reply, Mr. Allen has now distinctly stated that he would enlarge his cylinder three times, and cut off at about 1-7th of the stroke; and that the saving in fuel would be one-half, or from 5 lbs. to $2\frac{1}{2}$ lbs. per indicated H.P., with steam at 20 lbs. pressure on the safety-valve.

I need hardly remark that such a saving in fuel would be a decided step in the right direction. The enlarged engine, however, as proposed by Mr. Allen—query, is it practicable?

I will take a case in point—namely, the engines and screw gear of Her Majesty's ship, the *Duke of Wellington*, The following are some of the principal dimensions of this ship's machinery, &c.:—

Diameter of cylinders.................... $93\frac{3}{4}$ in.
Weight of engines and gear, about ... 350 tons.
Maximum speed of ship.................. 10 knots.
Power developed at the above speed 2,000 indicated H.P.
Steam carried down 3-4ths of the stroke.

Perhaps it would be proper to remark that my facts are taken, not from official documents, but from private notes taken in the course of an extended professional and practical career, and, though not official, they are *stated* on the *honour* of an engineer, and they are sufficiently near the *truth*.

To fully realise the saving proposed by Mr. Allen: the *Duke's* present cylinders have an area of 6,902 sq. in.; this, multiplied by 3, will give the new or enlarged cylinder an area of 20,706 sq. in., or a diameter of 162 in., or, in round numbers, 13 ft. 6 in. This fact alone opens up a wide field for discussion, for I need hardly remind Mr. Allen that in constructing steam machinery, the *mean pressure* exerted on a piston throughout the whole length of its stroke cannot be taken as an element in construction; but the initial pressure at the commencement of the stroke, even although the steam may be only carried down 1-7th of the stroke, is what the parts must sustain. For instance, the pressure on the *Duke's* present piston at the commencement and for 3-4ths the length of stroke will be:—

Pressure of steam, say 15 lbs. on the square inch.
Pressure of vacuum „ 12 „ „ „

Total .... 27 lbs. on the square inch of piston.

Area of piston.
Then, $6{,}902 \times 27 = 83$ tons on the present piston for 3-4ths of its travel.

The figures of the enlarged piston would stand thus:—

Pressure of steam, say 15 lbs. on the square inch of piston.
Pressure of vacuum „ 12 „ „ „

Total......... 27 lbs. „ „

Area of piston.
Then, $20{,}706 \times 27 = 249{\cdot}5$ tons on the enlarged piston for only 1-7th of its stroke.

Mr. Allen says, "that the nominal H.P. being increased to double would not increase the weights to a greater extent than 50 per cent."

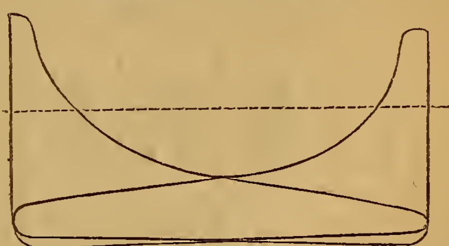
When I reflect that the initial strain to be sustained by the enlarged engine is as 249 to 83, I am not overstating it when I say that the increase of weight and strength of parts would be more like double 50 per cent.

The longer I live, and the greater experience gained, the more I feel convinced that *we* engineers ought not to be too dogmatical on any subject. Let me assure Mr. Allen that, however correct his various tables showing economy in fuel may be in theory, practical results very often tell another tale.

H.M.S. "DUKE OF WELLINGTON," *April* 7, 1855.

4th grade. Forward engine. (Smooth water.)

Steam...................... 12 lbs.
Barometer.................. $27\frac{3}{4}$ in.
Revolutions .... 22.



No. 1.

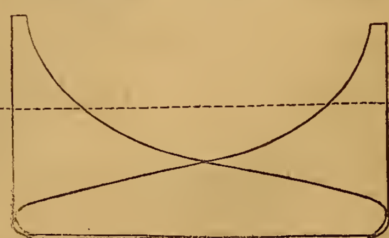
$\frac{6921 \times 8{\cdot}9 \times 198}{33{\cdot}000} = 369{\cdot}6 \times 2 = 739{\cdot}2$ total H.P.

Coals, 25 cwt. per hour, $\frac{25 \times 112}{739{\cdot}2} = 3{\cdot}8$ lbs. per H.P. per hour.

May 20, 1855. (Head-wind, force 6.)

3rd grade. Forward engine.

Steam.............................. $14\frac{1}{2}$ lbs.
Barometer .... $27\frac{3}{4}$ in.
Revolutions .... 20.



No. 2.

$\frac{6921 \times 9{\cdot}77 \times 180}{33{\cdot}000} = 369{\cdot}0 \times 2 = 738$ total H.P.

Coals, 35 cwt. per hour, $\frac{35 \times 112}{738} = 5{\cdot}3$ lbs. per H.P. per hour.

I append two diagrams taken from the engines of the *Duke of Wellington.* When these engines were working, as Mr. Allen would always have them do, he says, "but I say that what I want *always* done with ordinary engines *is* done when they are working expansively." *

No. 1 diagram shows the steam cut off very early. The mean pressure is 8·9; indicated H.P. 739·2, with a consumption of coal of 3·8 lbs. per H.P. per hour. This diagram, be it remarked, was taken with the ship steaming in smooth water.

No. 2 diagram was taken under different circumstances. The vessel was then making way against a head wind, force 6. The mean pressure in this case is 9·7; the indicated H.P. 738; but with a consumption of 5·3 lbs. of coal per H.P. per hour.

I will close these rambling remarks with a reference to the last paragraph of Mr. Allen's reply to my letter. He says—"I do not agree with 'Factus' that it would be desirable to dispense with condensation; and although I look forward with interest to the return of the high-pressure boats, yet he will find that little or nothing has been done in economising fuel, for the simple reason that the steam is not worked expansively enough (the cylinders being too small), and the advantage of condensation being disregarded—and for what?—to save weight and space occupied by an air-pump and condenser."

Admitted, Mr. Allen, as far as economy of fuel is concerned in the *marine engine*; this is certainly a *disputable* point, and one which I cannot at present establish by data.

But I cannot let you off so easily with the slighting sneer at the unimportance of *weight* and *space* occupied by the air-pump and condenser.

I am convinced that the high-pressure or non-condensing engine, apart from the boiler, has certain elements of the first importance, and which ought to take the first rank as constituting a good marine engine—namely, fewness of working parts and extreme simplicity, lightness combined with strength, and facility for stopping and starting, to which the condensing engine cannot be compared. Neither do I, personally, have any doubt but that, in point of economy, the high-pressure engine will be found equal, nay, superior, to the condensing.

But I have my doubts what is the best style of boiler for marine purposes, and how far these boilers would be suitable in *ocean* steam navigation.

To show the importance of *weight* and *space* I append the following table. The first two examples are selected because the indicated H.P. in the *Hogue* and *Cornwallis* are nearly equal, and are certainly fair as comparisons. The second two—namely, the *Porcupine* and *Pincher*, are also chosen for similar reasons, and both illustrate that the weight of the non-condensing to the condensing is as 1 to 5 in the case of the *Cornwallis* and *Hogue*, and as 1 to 6 in the *Pincher* and *Porcupine.*

Name of Ship and Description of engines.	Indicated H.P.	Nominal H.P.	Total Weight of Engines and Boilers.	Weight of Engines and Boilers per Indicated H.P.	Total Floor-space occupied by Engines.	Floor-space occupied by Engines per Indicated H.P.	Area of Piston.
	H.P.	H.P.	Tons.	Cwt. qr. lb.	Sq. ft.	Sq. ft.	Inches.
Hogue. Condensing engines.	716	450	200	5 0 18	28 × 30 = 840 sq. ft.	1·173	8332·28
Cornwallis. Non-condensing engines.	787·4	200	75	1 3 17	15 × 18 = 270 sq. ft.	·3429	1413·94
Porcupine. Condensing engines.	285·6	132	95	6 2 17	20 × 15 = 300 sq. ft.	1·05	3360·02
Pincher. Non-condensing engines.	275·6	60	15	1 0 9	10 × 10 = 100s q. ft.	·3628	590·2

The question of *space* is, if possible, more striking. The *Cornwallis* is $\frac{3}{10}$ths to 1·173 of the *Hogue*, while the *Pincher* is to the *Porcupine* as $\frac{3}{10}$ths to 1·05.

Apologising for the length of this communication, I hope I have shown, at least, that there is something to be said on both sides.

I am, yours, &c., FACTUS.

* See ARTIZAN for March, 1856, p. 671.

POSITION OF BRINE DISCHARGES.

To the Editor of The Artizan.

SIR,—In the last number of your most useful journal, a correspondent asks the opinion of sea-going engineers as to the best position of the mouth of the internal brine-pipe in steam-boilers?

An experience of eleven years at sea as an engineer has proved to me that the very bottom of the boiler is the most effective position for it; and I am led to that conclusion for the following reason:—

In almost all the boilers I have had anything to do with, the position of the mouth of the internal brine-pipe has been immediately over the furnaces, and on observing symptoms of priming, usually indicated by the dirty appearance of the water in the glass gauge, I have never found that opening the brine-cock has had the least effect in checking its progress.

If, however, the common blow-off cock at the bottom of the boiler has been opened, the priming has gradually subsided; thus showing that the sediment (which is more often the cause of priming than any other in well-constructed boilers) is more effectually carried away by the lower pipe than by the one placed nearer the surface of the water.

I see no reason why the additional brine-pipe might not be dispensed with altogether, and instead of it the usual blow-off cock placed in a more accessible position, with an index fitted to it for regulating the outlet.

This plan, besides having the advantage of simplicity, would obviate the necessity of extra holes being cut in the ship's sides for the brine-pipe discharges passing through; and we all know that the fewer in number these holes are the better.

I am, Sir, your obedient servant,

Portsmouth, March 18, 1856. CREDENDA.

THE IMPORTANCE OF SCIENCE IN ALL ARTS.

To the Editor of The Artizan.

SIR,—Gunpowder made with charcoal burnt in Dr. Fordyce's mode was said to possess a quality which, if true, must materially affect the goodness of the powder; I allude to what I heard General Congreve tell Dr. Fordyce towards the end of the last century, namely, that during a warlike expedition in Flanders, it was found that gunpowder made with charcoal burnt in the usual manner was all rendered useless by the moisture of the atmosphere in a rainy season, whereas that powder prepared with charcoal distilled in cylinders remained serviceable to the last. Now, it would seem desirable that this should be ascertained, and it might be done by an easy and little costly experiment.

This recurrence to by-gone days has led to reflections on the wonderful progress that arts and sciences have made. But was not the advancement prepared for in the latter part of the last century? Few existing individuals could have enjoyed an opportunity of hearing the opinions of eminent men in those days on the various branches of science, or have known the endeavours then made for their diffusion; a rare privilege accorded to me by my parents' permission to be present, whoever might be their guests. Dr. Fordyce's lectures on chemistry embraced nearly the whole round of physics; he gave three courses annually, the first two months of each daily lecture being strictly confined to the principles of chemistry, the other two to the principles of mechanism, &c., and the mutual dependence of the arts on one another, and on a general knowledge of the various sciences. He gave, besides, many private lectures to apply scientific knowledge to various arts, such as agriculture, brewing, dyeing, &c. The Earl Spencer, afterwards First Lord of the Admiralty, invariably attended them, as also Colonel Congreve, and thus originated his application of chemistry to the charring of wood, so efficient in charring the wooden buildings at the Ordnance Wharf at Woolwich.

But great as have been the discoveries in chemistry, influencing the air we breathe, the food we eat, and the healthfulness of our buildings, advancement in the last century was not confined to chemistry only. In mechanism especially, how important were the inventions, for though the turning lathe, and some of the Marquis of Worcester's inventions had long been in use, the circular saw, Bramah's ingenious tools for the manufacture of his well-known locks, Maudslay's various inventions, and Watt's steam-engines were all due to the last century. But why should I omit the late General Sir Samuel Bentham, whose patent, No. 1,951, in the year 1793, was brought to notice in Professor Willis' Exhibition Lecture, as so greatly facilitating inventors by its classification in the specification of the working of wood, metal, stone, &c. Another of Bentham's patents, of an entirely different nature, No. 2,035, in 1795, being for the employment of a vacuum to a great variety of manufacturing operations, instead of confining, as theretofore, the air-pump to scientific experiments, was as remarkable for the assistance afforded by its specification, which may be seen in the seventh volume of the Repertory, page 145. Fire-proof materials for the construction of buildings were also first devised in the last century by Sir Samuel.

Happily, at the present day, scientific principles are becoming part of the education of both rich and poor, as, for example, the cheap lectures at the Geological Institution; and to cite one county town, the useful education promoted by the enlightened patron of science, the Dean of Hereford. And to this more general diffusion of science may be ascribed most of the brilliant improvements of the last twenty or thirty years, for even Watt, though represented as a mere handicraftsman, was well versed in scientific principles, and his great improvement of the steam-engine resulted from the application of the scientific principle of the loss of heat occasioned by the condensation of steam. Thus, it may truly be said, that the advancement of all arts depend upon science. I am, Sir, &c., M. S. BENTHAM.

FUEL FOR THE PREPARATION OF IRON.

To the Editor of The Artizan.

Sir,—The notion seems to be gaining ground that vegetable fuel is essential for the preparation of strong iron; but to ascertain this point, and knowiug that the carronades with which the experimental vessels of 1795 were armed had withstood the shock of firing them, I requested some correspondent of the "Journal of the Society of Arts" to say whether the fuel used by the Carronade Company was mineral or vegetable, these carronades having been fired, without bursting, more frequently than the mortars at Sweaborg. Mr. Mushat—a great authority—has kindly replied to my query, stating that the fuel used at the Carron Works was mineral. I do not pretend to say that artillery is not deteriorated by use, for of course some portion of the metal is lost whenever the piece is fired, by the friction on the interior of the gun and other causes, but that is not the bursting of the gun, and does not render it unfit for use.

Mr. Mushat's communication is of great importance to all those who employ iron, for it must be evident that metal which can resist the strain occasioned by the explosion of gunpowder within it, the heat occasioned by it, and the cooling afterwards, is fit for all other purposes for which iron is used, save its destruction by chemical agents: hence it appears that for building purposes, iron smelted with pit coal is as good as that obtained by the use of charcoal. Unfortunately, the trials lately made at Woolwich of different kinds of iron, to ascertain the description of it most suitable for ordnance, is likely to confirm the notion that iron smelted with pit coal is less strong than that obtained where charcoal is the fuel, for the kind of iron that best resisted the bursting of the piece was prepared with charcoal. So, indeed, are many of the best kinds of iron, but this is caused by the comparative facility with which charcoal is obtained; for instance, in Sweden, in the Ural Mountains, and in Nova Scotia.

I am, Sir, &c., M. S. Bentham.

HIGH-PRESSURE STEAM: ITS GRADUAL DEVELOPMENT IN THE STATIONARY ENGINE.*

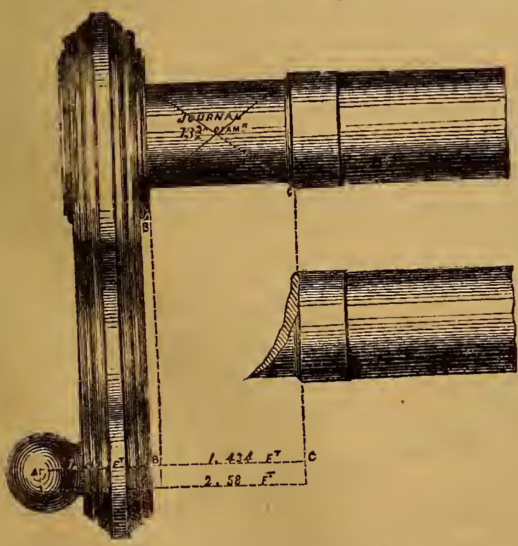
The following letter, received from a very talented and esteemed correspondent, bears so closely on this subject, that we give it entire:—

"My Dear Sir,—I now send you the promised sketches and calculations of breakages on our 80 H.E. at Upper D——, M——.

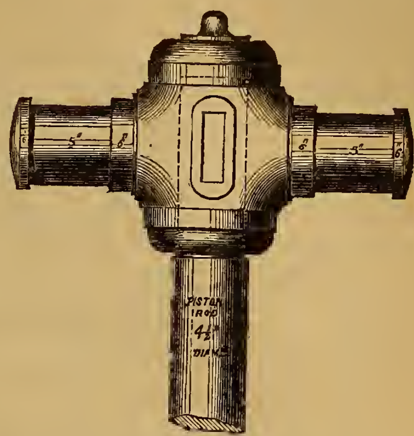
"I have discarded altogether the absurd mode of calculating the strength of parts based on a certain nominal H.P., which is more necessary, from the modern practice of using high-pressed steam. In the diagram here shown, which was taken a day or two before the breakage, the calculated power is 320 H.P., exactly four times the nominal H.P.,—this would be the data for calculating the strain on the parts, if the steam were carried out regularly to the end of the stroke; but seeing that the steam is cut off at about 1-3rd of the stroke, the strain must be greater at the moment of the greatest pressure of the steam. If this reasoning is correct, the greatest pressure, including both steam and vacuum, is 35·5 lbs. on the square inch of the piston. The area of piston is 1,662 inches, then 1,662 × 35·5=58,170 lbs., or 26 tons—the calculation of H.P. would be—

$$\frac{1,662 \times 35{\cdot}5 \times 308}{33,000} = 489 \text{ H.P.}$$

at the point of greatest pressure. I assume, then, for all purposes of calculation, 26 tons as the strain upon all parts of the engine.



"On the 7th December, the cross-head of the piston broke off, and the engine was stopped without doing further damage. The metal, on examination, was a solid casting, but appeared a piece of coarse-grained hot-blast iron; from the appearance of the fracture the break had been going on for some time. The diameter at the point of fracture is 6 inches, and from its construction we assume it as a bar of that size 12 inches between the supports. By the rule



given in Adcock, and also in Grier's Mechanics' Calculator, 4¾ inches diameter would be the size required to bear the strain, and both of them (namely, Adcock and Grier) are evidently wrong, in so far as actual practice is superior to theory.

"We replaced the cross-head with one made from Welch cold-blast iron, with many misgivings; more especially as we found that the opposite end of the broken cross head came away with a few blows of a hammer, and showed a fracture commencing exactly in the same place as on the broken end.

"On the 5th February (on a Monday morning), a few minutes after starting, the crank shaft of the same engine broke on the inside of the crank journal, or neck, as shown in the sketch, the broken end twisted itself out of the bearing, or pedestal, broke the connecting-rod into many pieces, carried away part of the sway-beam, at about the middle distance between the main centres and the connecting-rod ends, and the whole went down to the pit in one horrible smash, carrying floor and beams along with it in shapeless ruin. The recoil carried away the end of the cross-head at about the same place as before, and broke off the top of the piston-rod. Our old chief engineer, John Robertson, was standing at the steam-valves at the time; he describes it as one fearful crash, and before you could say *his name* all was hushed, and the place filled with a cloud of dust.

"By the table in Adcock, this shaft, of 13¾ inches diameter, running 22 revolutions per minute, is the size for an engine of 150 H.P.; by a table of torsion, in Grier, a 320 H.P. shaft should be 15 inches in diameter—so much for authorities.

"I think the proper way to calculate the strain on this crank-shaft is to take 26 tons as the weight, with a leverage from A to C (see sketch); the plummer-block, be it remarked, was never perfectly steady, but had a perceptible movement at every turn of the engine, the yielding of the bolts carrying the strain to the inner end of the journal; besides, the nature and position of the fracture showed that the break had not proceeded from torsion, for it showed that the oil had penetrated about 3 inches into a progressive break, and it was not exactly at one place, for some scales had been giving way in two places, 3-8ths of an inch apart; two of these I picked up ▬ shaped thus, being about 3 inches deep, and tapering off like a wedge, blackened with oil on both sides; but the conclusive proof of the nature of the *strain* was that the fracture was in the exact position on the shaft where the full pressure of the steam would, by this supposition, have been.

"In looking for a rule to calculate the strength of the shaft on this supposition, the only thing I can find applicable is in Tredgold, stated as follows:—'When a solid cylinder is fixed at one end, and the load applied at the other. Rule, multiply the leverage the weight acts with in feet by the weight in pounds—the fifth part of the cube-root of this product will be the diameter required in inches. Thus—

$$\left(26 \text{ tons, or } \frac{58,240 \text{ lbs.} \times 2{\cdot}58 \text{ ft. leverage}}{5}\right)\sqrt[3]{\ }=10{\cdot}64 \text{ in. diameter.'}$$

According to this rule, the crank-shaft, being 13¾ inches diameter, should bear 43 tons with this leverage.

"It is perfectly clear that there is not much dependence to be placed on the *tables* with the kind of iron now in use, and we are now replacing with best malleable iron all our *prime* movers, where we find them of similar strength to those which have given way.

"I shall be glad to hear any remarks you may have to make on the above, and will be obliged by your pointing out anything you think erroneous in the mode of calculation, or the data on which they are based.

"You will note from the diagrams that the steam is expended economically, but at a great risk of breakages. The consumption of fuel is 45 tons for 60 hours' work, or 5¼ lbs. per H.P. per hour; the boilers are, however, very faulty, only evaporating 12½ cubic feet of water at 130° per cwt. of coals, being less than 7 lbs. of water for 1 lb. of coals. I am, very truly yours, P.C."

This subject has grown upon us to such an extent, that we must reserve any further remarks till another occasion.

* From the "Engineering Journal."

ROYAL SCOTTISH SOCIETY OF ARTS.—Feb. 25, 1856.

Professor GEORGE WILSON, M.D., President in the Chair.

The following communications were made:—

1. *On the Adaptation of the Micrometer to the Levelling Telescope.* By Edward Sang, Esq., F.R.S.E.—The improvement described in this communication consists in moving the field-bar of the telescope by means of a micrometer screw. The divisions of the level-scale are made to correspond with those of the micrometer; so that, when the telescope is slightly out of position, the error can be corrected on the micrometer. In this way the very tedious operation of bringing a delicate level to its zero is avoided. By placing two wires at a proper distance from each other, a means is obtained of correcting directly for the curvature of the earth. But the chief facility is this, that when the utmost degree of precision is wanted, the wire is brought to the divisions on the staff, and the place at which the horizontal line cuts it obtained by computation.

2. *Description and Drawing of a Rifle-barrel, with Screw of Irregular pitch, and of various forms of Bullets.* By Mr. Peter K. Hunter, draughtsman, Cowlairs Station, Glasgow.—It was stated that this rifle may be made either oval or grooved. The principal difference from the ordinary rifle is, that the screw is *irregularly* pitched, commencing at the breech with a pitch of about five feet, and getting gradually quicker until it reaches the muzzle at a pitch of about two feet. By this method it is intended to impart *gradually* the rotary motion to the bullet, and prevent its riding over the screw thread, and the dangerous consequences in firing the Lancaster guns. The author also described a form of sight different from any in use; and also a form of bullet for firing with plain bored barrels. It was stated by Mr. Mortimer, that he believed that the irregularity in the pitch of the groove was included in Lancaster's patent.

3. *Description and Sketch of a new Mode of Steamboat Propulsion.* By Mr. P. K. Hunter.—The air is to be forced towards the stern of the vessel by a blowing-cylinder, and the blast orifice is under the water. The blast orifice is near the centre of the ship, on both sides of keel, and kept as far below the surface of water as the ship's draught will admit, and slightly inclined downwards, whereby, in the author's opinion, a resisting medium of 1 lb. per square inch of orifice would be obtainable for every two feet it is below the surface. It was stated by a member that this suggestion proceeds on a fallacy—viz., that more power would be obtained by the blast under water than if it were above water, and that, though the vessel in both cases would be propelled, it would be with a great loss of steam power.

4. *Letter to the Secretary on the subject whether Lightning Rods should terminate in a Point or Ball.* By J. Stewart Hepburn, Esq., of Colquhalzie.—The Secretary read a letter from Mr. Stewart Hepburn in reference to the discussion which took place last session on the subject of lightning conductors, in which he mentioned the common experiment where two conductors, one terminating in a point, the other in a ball or disc, were presented together to a charged battery. The discharge took place by the *pointed* conductor; not, however, at once by a *flash*, but by a *continuous stream;* showing, as he conceived, that the pointed wire, being only capable of drawing off an electric charge gradually, was inapplicable to the protection of buildings where it had to deal with atmospheric electricity darting in mass through the air from a distant cloud. And he ventured to suggest the possibility of bringing it to the test of experiment, by fixing to a large building two conductors, one pointed, the other with a ball, each being made to pass through a metallic case containing a charge of gunpowder, with a break within the charge to cause a spark. When a thunder-storm passed over the building, the explosion of one or other of the charged cases (whether heard or not) would show which of the conductors was best adapted for conveying the flash to the earth.

5. *Patented Improvements for Heating Bakers' Ovens.* By Mr. Alexander Hendry, Port-Glasgow. A model and drawings were exhibited and described.—The mode of heating patented by Mr. Hendry is by a series of pipes through which the heat passes from the furnace to the flue. These pipes rest upon bars of iron, about 15 in. from the sole of the oven, and heat the oven thoroughly, the sole as well as the roof, and the heat capable of being easier kept up than by the common method. He stated that there was a great saving in fuel, as, in place of good coal or wood, common dross can be used with good effect. Two such ovens when placed side by side can be heated by the same furnace. Mr. Hendry exhibited specimens of bread baked by his new mode of heating, showing that the sole of the oven was sufficiently heated—the bottom of the bread being equally if not better done than the top. He also stated that this method was much more cleanly, there being no fire introduced into the oven and no smoke.

NOTES AND NOVELTIES.

The New Metal, Aluminium.—Much attention has been excited upon the subject of the metal aluminium, and we perceive that many applications for patents connected with its use have been made. The ideas which originate these patents are, of course, based upon the presumed properties of the metal as detailed to us by the French chemists, with an additional colouring gained from the imagination of the inventor. It is superfluous to say that, under such circumstances, the results are but little likely to justify the expectations of the patentees; hence a few words of advice upon the subject may prove of use to the over-sanguine. The metal, so far from being almost as infusible as cast-iron, or even silver, melts more readily than zinc, and remains fluid upon a piece of dry wood, without sensibly burning it, as happens with tin or solder. It unites with scarcely any of the metals, and when united, in almost every instance loses its power of resisting oxidation; thus, it affords no chemical protection to iron as zinc does, but acts with it precisely as happens with tin (*i. e.*), the iron rusts wherever it is exposed to air and moisture; nor does the aluminium itself resist, under these circumstances, the same decomposing influences; on the contrary, it becomes rapidly coated with a white powder (alumina), and scales off. Tin and aluminium do not unite, but when brought into temporary contact by the intervention of another metal, the aluminium soon oxidises. With lead aluminium efuses to combine, though copper takes up a portion, and forms with it a bronze-coloured alloy. It may be made to unite with mercury, but the amalgam is very unstable, and soon oxidises. Upon the whole, therefore, we very much question whether this much talked of metal will ever be of much practical use, except when employed in its pure state; and at present the high price of aluminium (more than £30 per lb.) entirely excludes it from employment. It is, indeed, every way probable that a cheap mode of manufacturing it will soon be discovered, and something of the kind is already whispered about; but, until the event becomes a marketable fact, we see no reason to indulge in prospective hopes that aluminium will ever substitute tin. —*From the Journal of Gas Lighting, Water Supply, and Sanitary Improvement.*

Panama Railroad.—We gather from a recent official report on this work, that its entire length is 47 miles and 3,020 feet. The maximum grade is 60 feet to a mile, descending from the summit towards the Pacific; on the descent from the summit towards the Atlantic, the maximum is $58\frac{8}{100}$ feet to a mile. $23\frac{3}{4}$ miles are level, and $28\frac{3}{4}$ miles are straight. It is a single track road, laid partly with a bridge or ∩ rail of 58 lbs. per yard; and partly with a T rail of 56 lbs. The gauge is not stated. Its cost, including rolling stock, land, depôts, &c., will be about seven and a half millions of dollars, or about 158,000 dollars per mile.—*Journal of the Franklin Institute.*

Illuminating Gas from Peat.—Few towns or isolated buildings in England and Scotland but are supplied with gas-light, principally on account of the abundance of coals, and consequent cheapness in those countries. Not so in Ireland, where coals are scarce, and their cost considerable. Gas-light is not at all in general use. An invention has lately come under our notice for the generating of illuminating gas from peat, which deserves much attention. Mr. Richard L. Johnson, of 48, Mary-street, Dublin, has fully demonstrated that peat will yield a gas-light of great brilliancy, and in quantity, from a given weight, such as to warrant its general use in all parts of Ireland. There also remains, after producing the gas, charcoal, which is at present used for deodorising purposes, and which is considered valuable in the smelting of metals, in preparation of gunpowder, and many other purposes. The bogs of Ireland have been regarded useless wastes. It is now truly gratifying to us to state that they constitute a source from whence may be derived one of the most useful of modern discoveries, viz., gas-light.—*Irish Reporter.*

Coal-tar as a Manure.—Mr. Atkinson, near Durham, upon whose farm an experiment was tried, writes as follows:—"The experiment with potatoes planted upon Seaham Glebe farm is as follows:—With gas-tar and farm-yard manure, 6 tons 8 cwt. 3 qrs. per acre. Without gas-tar and same quantity of farm-yard manure, 6 tons 11 cwt. 3 qrs. 4 lbs. per acre. The gas-tar being only fourteen days mixed with farm-yard manure before being applied to the soil in the potato rows, prevented part of the plants from growing; yet I felt surprised at the result, for when the potatoes were turned out with the plough in the rows the potatoes planted with the gas-tar were larger, and appeared, to the eye, the better crop."

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 19th October, 1855.

2343. William Armand Gilbee, 39, Rue de l'Echiquier, Paris—Improvements in the application of silicate of potash to hardening and preserving stones and calcareous metals. (A communication.)

Dated 1st December, 1855.

2711. Sir Charles Edward Grey, 38, Rue du Mont Thabor, Paris—The use of a new vegetable material for raising the nap and dressing woollen cloths and webs and tissues.

Dated 10th December, 1855.

2785. Peter Armand Le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in obtaining motive-power by means of heated compressed air. (A communication.)

Dated 31st December, 1855.

2952. Sir John Scott Lillie, Pall-mall—Improvements in guns, fire-arms, and implements of war connected therewith.

Dated 3rd January, 1856.

20. Hermann Brambach, Cologne—Converting dry pitch, and other resinous substances, also coal tar and other tars, into neutral essential oils.

Dated 11th January, 1856.

87. William Smith, Little Woolstone—Improvements in ploughs and other cultivating implements.

Dated 16th January, 1856.

111. Thomas Dunn, Windsor Bridge Iron Works, Pendleton—Improvements in boilers and apparatus for heating water and generating steam.

Dated 17th January, 1856.

132. William Westbrooke Squires, M.D., Liverpool—Improvements in preventing the bursting of pipes and tubes for conveying liquids.

156. Samuel Ratcliffe Carrington, Stockport—Improvements in the manufacture of hats, and in machinery or apparatus connected therewith.

Dated 23rd January, 1856.

178. William Johnson, 47, Lincoln's-inn-fields—Improvements in the treatment and application of fatty, resinous, and gummy substances, and in the manufacture of pastes, greases, and soaps. (A communication.)

Dated 25th January, 1856.

205. Gentle Brown, Swinton, near Rotherham—Improvement in the manufacture of cast steel.

207. Alexis Jean Dessales, 13, Rue des Enfants Rouges, Paris—Improvements in oil lamps and in reflectors for the same for railway carriages and other purposes.

Dated 26th January, 1856.

209. Alexander Dalgety, 76, Florence-road, Deptford—Improved self-acting stand or stilt for casks or barrels.

211. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in compressed air locomotive engines. (A communication.)

213. Patrick Doran, 10, Cornwallis-street, Liverpool—Improvements in pneumatic apparatus for raising sunken vessels or other bodies under water, and for keeping afloat vessels or other bodies liable to sink.

215. William Spurrier, Birmingham—Improved method of attaching handles to metallic tea pots and other vessels, which method of attachment may also be

applied to the fixing of castors on furniture and other like purposes.
217. Wilhelm Dreschfeld, Manchester—Improvement in, or addition to, rollers employed in spinning.
219. Alexander James Walker, New York, and William Bennett, Brooklyn, New York—Improved method of forming hat-bodies, or other felted articles.

Dated 28th January, 1856.

220. Abram Longbottom, 41, Moorgate-street, and William Longmaid, Victoria-cottage, Stoke Newington—Improvements in apparatus for generating and heating steam.
221. Peter and George Brown, Liverpool—Improvements in the method of cleaning, dressing, and preparing a certain description of seed or grain, called "dari," and frequently called "millet," and thereby rendering the same suitable for food.
225. Jean Baptiste Jules Hyppolite d'Auvergne, Blois—Improvements in portable writing or drawing desks.
227. Pierre Emmanuel Guerinot, Rue au Maire, Paris—Stopping instantaneously two railway trains running against each other.
229. Samuel Jabez Goode, Aston, near Birmingham—Improved gas stove.
231. Jean Hector Destibeaux, Paris—Improved waterproof fabric.
233. Henry Samuel King, Cornhill—Improved apparatus for printing and embossing. (A communication.)

Dated 29th January, 1856.

235. William John Simons, Royston—Improved governor for steam and other engines requiring governors.
237. William Henry Lancaster and James Smith, Liverpool—Improved arrangements for the application of gas and atmospheric air to the generation of heat in furnace or other flues, and the consumption of smoke.
239. James Fleming and George Fyfe, Glasgow—The consumption of smoke in engine and other fires.
241. William Fowler and William McCollin, Kingston-upon-Hull—Improved threshing-machine.
243. Samuel Palmer Gladstone, Lea-cottage, Orchard-house, Poplar—Improvements in the construction of masts and yards.
245. Abraham Pope, Edgware-road—Improvements in the manufacture of iron, copper, tin, and lead.

Dated 30th January, 1856.

247. Robert Walter Winfield, Birmingham—Improvements in the manufacture of metallic bedsteads and other articles of metallic furniture.
248. John Henry Walsh, Portland-place, Clapham-road—Improvements in omnibuses.
249. John Toward, Glasshouse Bridge Iron Works, Newcastle-upon-Tyne—Improvements in iron ship-building, and in iron plates therefor, which plates are also applicable to other purposes where great strength is required.
250. Charles Frederick Claus, Latchford, Chester—Improvements in the preparation of hides or skins, also applicable to the preparation of the entrails of animals.
251. Alfred Vincent Newton, 56, Chancery-lane—Improvement in the manufacture of cannon. (A communication.)
252. William Gossage, Widnes—Improvements in the manufacture of certain kinds of soap.
253. Thomas Fewster Wilkinson, 25, Bloomsbury-street, Bedford-square—Improvements in reaping and mowing machines.
254. John Lee Stevens, London—Improvements in doors or apparatus for regulating the supply of air to steam boiler and other flues and furnaces.
255. John Gretton, Burton-upon-Trent—Improvements in brewing.

Dated 31st January, 1856.

256. John Stokes, Birmingham—Improvements in fog signals.
257. Henry Holford and Mark Mason, Newton Iron Works, Hyde, Chester—Improvements in machinery or apparatus for compressing metals and for manufacturing all kinds of metallic rivets, bolts, or similar articles.
258. Aubin Emile Coullard-Descos, Paris—Improvements in consuming smoke.
259. James Mash, Manchester—Improvements in working the valves of steam-engines.
260. George Napier, Bath-street, Glasgow—Improvements in apparatus for raising, lowering, and suspending boats from ships.
261. Henry Tylor, New Bond-street—Improved joint, applicable to cots, bedsteads, and other frames in metal.
262. John Kinniburgh, Renfrew—Improvements in moulding or shaping metals.
263. Joseph Harrison and John Oddie, Blackburn—Improvements in machines for winding yarn or thread on to spools or bobbins.
264. Thomas Burdett Turton and John Root, Sheaf and Spring Works, Sheffield—Improvements in buffer, bearing, and draw springs.
265. Henry Render, Manchester—Improved lubricating materials.
266. Frederick Kersey, 5, Laurie-terrace, St. George's-road, Southwark—Improvements in the manufacture of drain-pipes.
267. George Hallen Cottam and Henry Richard Cottam, Old St. Pancras-road — Improvements in folding bedsteads and chairs.
268. John Barker Anderson, East-hill, Wandsworth—Improvements in the manufacture of soap, parts of which improvements are applicable to preparing materials for the purposes of illumination, and also for the purposes of lubrication.
269. Thomas Hurst, Tanner-street, Barking—Improvements in the connecting of the rails or metals generally used on railways.
270. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in gas burners, and in regulating the combustion of gas. (A communication.)

Dated 1st February, 1856.

271. Allan Macpherson, Brussels—Improvements in obtaining and applying motive-power. (A communication.)
272. Matthew Ker, 8, Cumberland-market—A machine for sweeping carpeted and other floors.
273. Edward Schischkar, Halifax—Improvements in dyeing and colouring wools, hairs, silks, yarns, and textile fabrics made of the same materials either wholly or partially.
274. Francis Preston, Manchester—Improvements in machinery for shaping and rolling metal.
275. George Holcroft, Joseph Smith, and Thomas Holcroft, Manchester—Improvements in machinery for preparing, spinning, and doubling cotton and other fibrous materials.
276. Charles Robert Moate, 65, Old Broad-street—Improvement in securing and sustaining the rails of railways.
278. William Dray, King William-street—Improved cartridge-box and pouch.
279. Andrew Lamb and John Ronalds, Southampton—Improvement in the construction of iron ships, boats, and other similar structures.
280. Francis Best Fawcett, Kidderminster—Improvements in the manufacture of carpets.
281. Henry Bestwick and Joseph Bury, Manchester—Improvements in cocks, taps, or valves.
282. George Norgate Hooper and William Hooper, Haymarket—Improvements in springs for carriages, and for the cushions of carriages, chairs, mattrasses, beds, and other similar articles.
283. James Timmins Chance, Birmingham—Improvements in furnaces used for flattening glass.
284. George Duckett, 5, Norfolk-terrace, Westbourne-grove-west, Bayswater—Improvements in carts and vans.
285 Auguste Eugène Dannequin, Rue de l'Echiquier, Paris—Improvements in caoutchouc, or any other waterproof garments.
286. Charles Catherine Joubert, Rue de Moscow, and Leon André Bordier, Rue de la Ferme des Mathurins, Paris—Improvements in motive-power engines.
287. Benjamin Franklin Miller, New York—Improvements in ventilators for chimneys and other purposes.
288. John O'Meara Beamish, Trafalgar-road, Old Kent-road—Improvements in the manufacture of morocco leather.

Dated 2nd February, 1856.

289. James Townsend Ward, Swansea—Improved omnibus.
290. John Rock Day, Birmingham—Improved door lock and latch.
292. Benjamin Burleigh, Great Northern Railway, King's-cross—Improvements in certain parts of the permanent way of railways.
293. William Joseph Curtis, 1, Sebbon-street, Islington—Improvements in machinery for excavating land for the constructing tunnels.
294. William Goodman, 6, Canning-place, Leicester—Improvements in machinery for producing knit or looped fabrics.

Dated 4th February, 1856.

296. Richard Clarke Pauling, 18, Great George-street, Westminster—Expelling water from vessels and keeping them from sinking, raising sunken vessels, keeping water out of coffer dams, caissons, foundations, or vessels, or works that are below water, and propelling vessels on and through water.
297. Rudolph Bodmer, 2 Thavies-inn, Holborn—Improved lubricating oil. (A communication.)
298. Ralph Waller, Manchester—Improvements in preparing cotton and other fibrous materials.
299. Elisha Smith Robinson, Bristol—Improvements in machinery for lithographic and zincographic printing.
300. Charles Henry Hudson, 4, Highbury-cottages, Holloway-road—A retiring door or lid for boxes, cabinets, closets, rooms, carriages, and for all places or receptacles where or in which doors or lids are at present in use or may be used.
301. Edwin Clark, 24, Great George-street, Westminster—Improvement in the apparatus for suspending insulated electric telegraph wires.
302. Matthew Whiting, jun., Manning-street, Bermondsey—Improvements in preparing for, and in, tanning hides and skins.
303. John Thomson, Newton-le-Willows — Improvements in centrifugal apparatus to be used in the separation of liquids from granular and crystalline matters.
304. Nathan Agar, Upper Ebury-street, Pimlico—Improvements in connecting spindles of locks and latches with their knobs and handles.
305. William Allen Turner, 125, Wood-street, Cheapside—Improved preparation or mixture to be used in the manufacture of compounds of india-rubber or caoutchouc.
306. Thomas Mills, Leicester—Improvements in machinery for the manufacture of looped fabrics.

Dated 5th February, 1856.

307. George Cumins Thomas, Washington, U.S.—Improved method of hardening and tempering steel. (A communication.)
308. Frans Victor Oscar Hyckert, Paris—Improvements in heating.
309. Thomas Hinchliffe, Mill-bridge, Liversedge—Improvements in machinery or apparatus for "drawing" and "spinning" wool or other fibrous substances, or wool mixed with other fibrous substances.
310. Michael Leopold Parnell, 283, Strand—Improvement in the construction of locks.
311 Theodore Bergner, Philadelphia, U.S.—Embossing veneers, so as to represent carvings in wood. (A communication.)
312. Francis Montgomery Jennings, Cork—Improvements in bleaching vegetable fibres.
313. James Howard, Bedford—Improved apparatus for making moulds for castings.
315. Alfred Augustus De Reginald Hely, 296, Oxford-street—Improvements applicable in the burning of gas.
316. Thomas Williams, Clerkenwell—Improvements in omnibuses.
317. Henry Squire, 41, Ludgate-hill—Improved seal or fastening for envelopes, deeds, and documents.

Dated 6th February, 1856.

318. George Napier, Bath street, and John Miller, Cavendish-street, Glasgow—Improvements in the mode of driving and in applying screw propellers to the propulsion of vessels.
319. Joseph Thomas, Finsbury-square—Improvements in the manufacture of soap from the greasy matters obtained from the refuse water, wash, or suds used in woollen or other manufactures or processes. (A communication.)
320. John Dodgeon, Burnley, and James Wilson Bateson, Rawtenstall—Improvements in looms for weaving.
321. John Fletcher and William Fletcher, Salford—Improvements in the construction of weighing-cranes and other similar elevating machines.
322. John Inshaw, Birmingham—Improved pressure-gauge.
323. Henry Alfred Jowett, Kentish-town—Improvements in railway breaks and carriages, and in signals connected therewith.
324. Charles Victor de Sauty, St. Mary's-terrace, Walworth—The prevention of the leading or fouling of fire-arms.
325. Thomas Frederick Tyerman, Weymouth-street, Portland-place — Improvements in apparatus to be applied to omnibuses and other carriages for receiving wet umbrellas.
326. Franklin Prestage, Wylye, Heytesbury—Improvements in locomotive engines.
327. James Edward Duyck, Wandsworth—Improvements in the manufacture of oil cake.
328. Charles Frederick Philippe Funcke, Herdecke, Westphalia—Improvements in tanning skins and hides.
329. James Meacock, Snow-hill—Improved means of fixing diaphragms in gas meters.

Dated 7th February, 1856.

330. Richard Bleasdale, Rochdale—Improvements in the machines for spinning called throstles.
331. Theodore Bergner, Philadelphia, U.S.—A new mode of preparing or facing surfaces of engraved or etched plates of metal, or other substance, so that they may be readily printed from by a press without wiping. (A communication.)
333. Richard Archibald Brooman, 166, Fleet-street—A method of obtaining alcohol from the fruit or pod of the Carob tree. (A communication.)
334. Henry Berlette, Boulogne-sur-Mer—Improved apparatus for roasting coffee.

Dated 8th February, 1856.

335. John Woodman, Manchester—Improved telegraph insulator.
336. Theophile François Trocard, Bordeaux-town—Improved coffee-pot.
338. Henry Alfred Jowett, Kentish-town—Improvements in rails used for the construction of the permanent way of railways, and in the means of laying down and fixing them in conjunction with the present rails in use.
339. Stewart Robertson and James Howden, Glasgow—Improvements in machinery or apparatus for driving piles.
340. Charles Walker, Glasgow—Improvements in safety-valves and in apparatus for cleansing or purifying water in steam-boilers.
341. John Billington Booth and James Beckett, Preston—Improvements in machinery for preparing and spinning cotton, wool, and other fibrous materials.

Dated 9th February, 1856.

342. Charles Swan and George Frederick Swan, 49, High-street, Southwark—Improved colouring matter for writing, staining, or dyeing, which is also applicable to the production of a copying fluid. (A communication.)
343. John Elce and Samuel Fletcher Cottam, Manchester—Improved mode of lubricating the spindles of machinery used in preparing and spinning cotton and other fibrous materials revolving in a lifting rail.
344. George Wailes, 10, Palace-row, New-road—Improvements in the construction of valves for regulating the passage of gas and other fluids.
346. John Rawlings, Bishopsgate-street—Improvements in envelope or stationery cases.

347. Edward Martin, Oxford—Improvements in cricket-bats.

348. Theophilus Burton, Lincoln — An internal boiler cleaner, or mud stirrer, for the effectual cleaning of steam-boilers from muddy deposits and all kinds of sediments.

349. Theodule Cavé, Paris—Improvements in oil lamps, which he calls the "Continual Lamp."

350. Louis Schwartzkopff, Berlin—Improvements in apparatus for raising mud and soil from the bottoms of rivers and other waters.

351. William Augustus Bullard, Dedham, Massachusetts, U.S.—Improvements in instruments for fastening doors. (Partly a communication.)

Dated 11th February, 1856.

352. Christophe Muratori, Paris—Improvements in the waterproofing of hangings or ornamenting stuffs.

353. William Horatio Harfield, 113, Fenchurch-street—Improvements in the manufacture of metallic screw nuts. (A communication.)

354. William Henry Zahn, New York, and Joseph Henry George Wells, 3 Ebenezer-place, Neckinger-road, Bermondsey—Improvements in windmills or wind engines.

355. Thomas Steven, Milton Foundry, Glasgow—Improvements in the construction of open and close stoves, which improvements are applicable in part to kitchen ranges and boiler fire-places.

Dated 12th February, 1856.

356. Henry Bessemer, Queen-street-place, New Cannon-street—Improvements in the manufacture of malleable or bar iron and steel.

357. Joseph Marie Guidicelli, 34, Rue Bonaparte, Paris—Improvements in the transformation of movement in steam-engines and other machinery.

358. George Tomlinson Bousfield, Sussex-place, Loughborough-road—Improvement in treating fats and oils. (A communication.)

359. Richard Archibald Brooman, 166, Fleet-street—Improvements in the manufacture of cast steel. (A communication.)

360. Felix Pruss Jablonowski, Brussels—A new process of chromo-lithographic painting on glass, porcelain, clays, lava, and other materials susceptible of vitrifaction, and on all metals and metallic compounds capable of receiving an enamelled surface.

Dated 13th February, 1856.

361. Frederick Steiner, Accrington—Improvements in machinery to be used in drying fabrics.

362. Pierre Isidor David, Paris—Improvements in the method of bleaching.

364. Louis Vignat, 3, Place des Victoires, Paris—A regulator-compensator for the weaving of ribbons and cloths.

365. William Frederick Collard Moutrie, 4, King-street, Holborn—Improvement in the damper action of pianofortes.

366. Samuel Fox, Stocks-bridge, Peniston, York—Improvements in springs for railway and other carriages.

367. Richard Knight, Foster-lane—Improvements in medical chests.

368. William Gilchrist, Kirkintillock, Dumbarton—Improvements in ornamental weaving.

369. William Edward Newton, 66, Chancery-lane—Improvements in the manufacture of zinc. (A communication.)

370. Willinm Edward Newton, 66, Chancery-lane—Improvements in the construction of fire-arms. (A communication.)

371. Alfred Vincent Newton, 66, Chancery-lane—Improvements in springs, applicable to railroad carriages and to other uses. (A communication.)

372. Henry Fort Mitchell and William Mitchell, and John Clarkson, Silsden, near Keighley—Improvements in sewing-machines.

373. John Barber, Manchester—Improvements in steam-engines.

374. Gustave Louis Keller, Paris—A new kind or system of carpet or travelling bag.

375. William Parsons, 33, Hugh-street, Pimlico—Improvements in spindles for locks and latches.

Dated 14th February, 1856.

376. Thomas Parkinson Capp, 67, Gracechurch-street—Improved lamp.

378. Henry Robert Ramsbotham and William Brown, Bradford — Improvements in combing wool, alpaca, cotton, and other fibrous substances.

379. Stephen Rossin Parkhurst, New York—Improvements in sails and rigging for vessels.

380. Walter McFarlane, Glasgow—Improvements in building and structural works, and fittings in metal.

381. John Emsley, Bolton-road, Bradford—Improvements in tube spinning frames employed in spinning worsted yarn and other fibrous substances.

382. George Pate Cooper, 18, Sutherland-square, Walworth—Improved shirt collar.

383. John Taylor, Spring-grove, Hounslow—Improvement in constructing and facing walls.

384. William Hammond Bartholomew, 15, Brunswick-terrace, Leeds—Improvements in propelling vessels when screws or submerged propellers are used.

385. Edmund Morewood and George Rogers, Enfield—Improvements in drying and coating iron and copper.

386. William Watson Hewitson, Headingley, near Leeds—Improvement in casting the bearings or brasses of machinery.

387. Thomas Evans Blackwell, Clifton, near Bristol—Improvements in condensing steam, and in cooling and heating fluids.

388. Charles Cowper, 20, Southampton-buildings, Chancery-lane—Improvements in impregnating wood with preservative and colouring materials, and in apparatus for that purpose. (A communication.)

389. George Gulliver and John Goldthorpe, Barnsley—Improved signal bell.

390. Edouard Deiss, Paris—A method or methods of, and apparatus for, extracting oils, fats, greases, and resins from bones, raw wool, seeds, and other substances containing the same, and recovering a certain agent employed in the process.

Dated 15th February, 1856.

392. Alexandre Tolhausen, 7, Duke-street, Adelphi—A machine for cutting articles of polygonal figure in wood or other material. (A communication.)

394. James Hogg, junior, 4, Nicolson-street, Edinburgh—Improvements in the manufacture of envelopes and certain other combinations and applications of paper and gum, denominated "Letter Checks," for containing and securing written, printed, or other communications.

396. Eddlestone Elliott, Cyrus Leach, and James Ratcliffe, Rochdale—Improvements in machinery for spinning wool and other fibrous substances.

398. William Edward Newton, 66, Chancery-lane—Improved machinery for making boots and shoes. (A communication.)

Dated 16th February, 1856.

400. Frederic Daniel Grant, Newgate-street—A method of rendering printing inks and wax odoriferous.

402. George Harrison, 4, Little Goodwin-street, Hull—Improvements in axles for railway carriages.

Dated 18th February, 1856.

406. James Strang Thomson and Andrew Barclay, Kilmarnock—Improvements in printing and embossing textile fabrics and other surfaces, and in the production of apparatus to be employed therein.

408. Moses Jones, William Broad Rowe, and William Perrins, Broad-street, Worcester—Improvements in ranges.

410. William Hale, Swan-walk, Chelsea—Improvements in propelling boats or other floating bodies.

Dated 19th February, 1856.

412. Henri Gerbaut, Mulhouse — Improvements in the manufacture of vinegar.

414. Frederick Austin Spalding Witter, Manchester—Improved stove. (A communication.)

416. Stephen Fitchew Cox, Bristol—Improvements in the manufacture of leather, and in machinery for that purpose.

418. John Gedge, 4, Wellington-street-south, Strand—Improvements in pumps. (A communication.)

420. William Gwillim Merrett, 49, Leadenhall-street — Improvement in trousers and drawers.

422. Richard Waygood, Newington-causeway — Improved portable laundry, or combined boiling, washing, mangling, and drying and ironing apparatus.

Dated 20th February, 1856.

424. Richard Laming, Carlton-villas, Maida-vale — Improvements in purifying gas, in preparing materials useful for purifying gas, and in apparatus to be used in purifying gas and disinfecting gas liquors or washings.

426. William Muir, Britannia Works, Manchester—Improvements in slide lathes.

428. William Lynn, H.M. Dockyard, Portsmouth—Improvements in the construction and mode of applying screws for propelling vessels.

430. Richard Archibald Brooman, 166, Fleet-street—Improvements in working railway switches and crossings, and certain indicating apparatus for preventing accidents on railways. (A communication.)

432. William Clibran and Joseph Clibran, Manchester—Improvements in, and applicable to, apparatus or mechanism for measuring and regulating the flow of gas, and in the mode of constructing parts thereof.

434. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in machinery or apparatus for lubricating bearings, parts of which improvements are applicable to the raising or elevating of liquids. (A commuoication.)

Dated 21st February, 1856.

440. Isaac Moll, Cologne—The treatment of sulphate of alumine of commerce, and its formation of compounds, useful for the disinfecting of organic substances in a state of putrefaction, as well as for other purposes.

442. Jacques Henri Marie Maissait, Paris—Improvements in projectiles for fire-arms.

444. Thomas Bennett and Wilfred Preston Dugdale, Farnworth—Improvements in flyers used in spinning machinery.

446. Frederick Enthoven, Moorgate-street—Improved cover for gunpowder and other canisters and vessels. (A communication.)

448. William Clarke, Nottingham—Improvements in the manufacture of warp fabrics.

Dated 22nd February, 1856.

452. John Sharp Cromaotie Heywood, Battle-bridge, and George Lloyd, Great Guildford-street, Southwark—Improvements in condensing vapours in distillatory operations, the manufacture of varnishes, melting and distilling of fats, and other manufacturing or chemical operations, and obtaining useful products therefrom.

454. John Kingsford Field, Lambeth, and Charles Humfrey, 14, The Terrace, Camberwell—Improvements in the manufacture of paraffine candles.

456. James Griffiths, Wolverhampton—Improved break for colliery and other steam-engines.

Dated 23rd February, 1856.

460. Edward Schischkar, Halifax—Improvements in cleansing silk, hair, wool, yarn, and textile fabrics.

464. George Holme Spencer, Heathersage, near Sheffield—Improvements in the manufacture of card surfaces employed in carding cotton and wool.

466. Thomas Goode Messenger, Loughborough—Improvements in boilers.

468. Joseph Scudamore, Mitcheldean, Gloucester — Improvement in domestic stoves or grates.

470. Henry Loveridge, Wolverhampton—Improvement in feet, hip, and slipper baths, also in bases for shower baths and basins for washing, and other purposes.

472. Samuel Rodgers Samuels, Nottingham — Improvements in weaving fabrics.

Dated 25th February, 1856.

474. Louis Normanby, 67, Judd-street, Brunswick-square—Improvements in the mode of constructing and fixing the rail of railways. (A communication.)

476. Frederick Kersey, 5, Laurie-terrace, St. George's-road, Southwark—Improvement in the manufacture of drain-pipes.

478. Robert Hawthorn and William Hawthorn, Newcastle-upon-Tyne—Improved arrangement of steam-pump.

480. Charles Frederick Claus, Latchford, Chester—Improvements in metal shipbuilding, applicable also to steam-boilers, bridges, and other structures in which metal plates are used.

482. Charles Damas Auguste Joseph Planque, Pont St. Maxence, France—Improvements in the manufacture of fecula.

484. Edward Slaughter, Avonside Ironworks, Bristol—Improvements in the fire-boxes of locomotive and other steam-boilers.

Dated 26th February, 1856.

486. James Prescott Joule, F.R.S., Manchester—Improvements in steam-engines.

490. James Steedman, Albany-street — Improvement in pianofortes.

492. Philip Schafer and Frederick Schafer, Brewer-street—Improved apparatus for damping gummed stamps, tickets, labels, and envelopes.

494. Richnrd Archibald Brooman, 166, Fleet-street—Compositions to be used as a substitute for hops in brewing. (A communication.)

496. Isaac Reckitt, George Reckitt, and Francis Reckitt, Kingston-upon-Hull—Improvements in the manufacture of starch, British gum, and size.

Dated 27th February, 1856.

498. Gabriel Marie Legrand, 57, Rue de Bretagne, Paris—Improvements in graining and chequering skins and woven tissues.

500. John Henry Johnson, 47, Lincoln's-inn-fields—Improvements in the treatment of hard india-rubber for the purpose of rendering the same applicable to the manufacture of pens, tubes, springs, and other similar articles. (A communication.)

502. William Exall, Reading—Improvements in the manufacture and arrangement of sawing machinery.

504. Alexander Inglis, New River Head, Clerkenwell—Improvement in the manufacture of flexible bottles or cases for containing colours and other fluids and semi-fluids.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

355. John Wallnce Duncan, Grove-end-road, St. John's-wood—Improvements in or connected with apparatus for the generation and application of steam for impelling purposes.—9th February, 1856.

423. William Aristides Verel, Macduff, Banff—Improvements in grinding or pulverising hoofs and horns, and in using them alone or mixed with pulverised bones for mnnure.—20th February, 1856.

481. Louis Arnier, Marseilles—Improvements in condensing hot air and obtaining motive-power therefrom.—25th February, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.

Feb. 15, 3810. P. and F. Schafer, 12, Brewer-street, Golden-square, "Travelling Bottle and Glass."

,, 18, 3811. Frederick Allies, Worcester, "Fishing Winch Reel with Check."

,, 27, 3812. Seth Dixon and Edmund Eyres, 17, Savoy-street, Strand, "Improved Cap for Travelling Bags."

Mar. 4, 3813. Sampson, Mordan, nnd Co., 22, City-road, London, "The Combined Copying Press nnd Inkstand."

,, 5, 3814. Willinm Sawney, Beverley, Yorkshire, "Cliver or Hariff Apparatus."

,, 5, 3815. Butterworth and Co., 2, New Dover-street, Southwark, "Improved Elastic Boot Fastening."

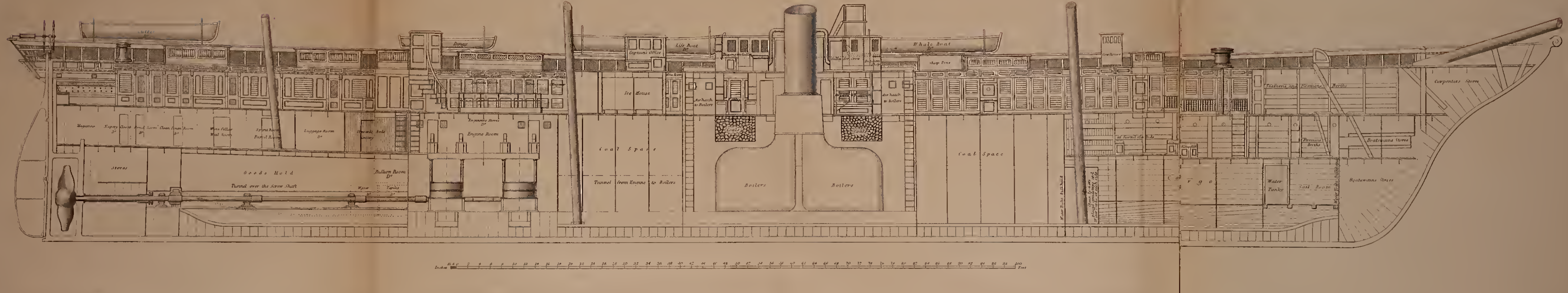
,, 11, 3816. James Flanagan, Manchester, "Improved Shirt Neck Band or Collar."

,, 12, 3817. John Clayton, Denton, near Manchester, "A Stove or Furnace for Heating Hatters' Irons."

LONGITUDINAL SECTION OF THE SCREW STEAM TRANSPORT "EMEU"

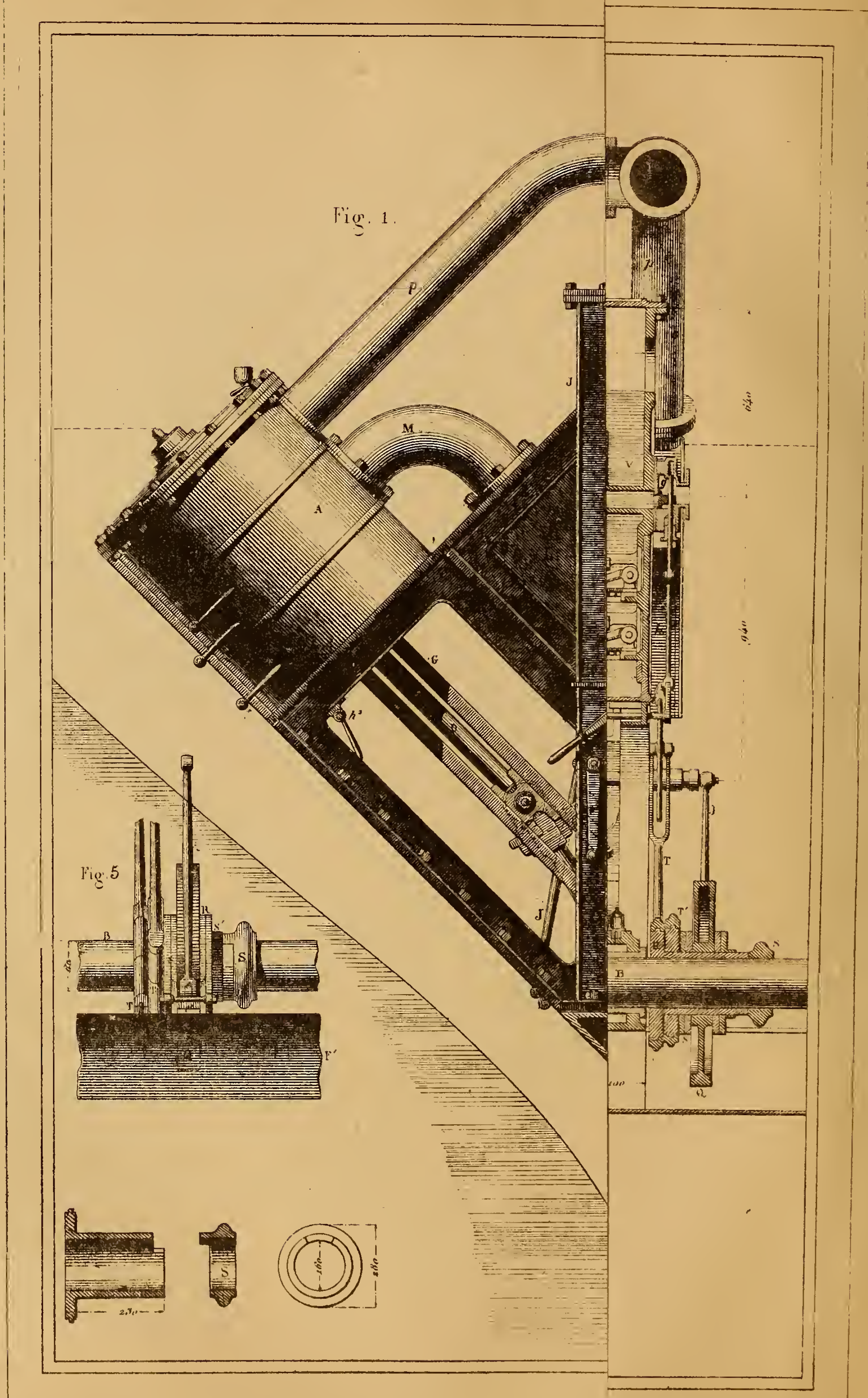
CONSTRUCTED BY

ROBERT NAPIER & SONS _ GLASGOW.



W. Smith del. & Aresc.

J. W. Lowry fc.



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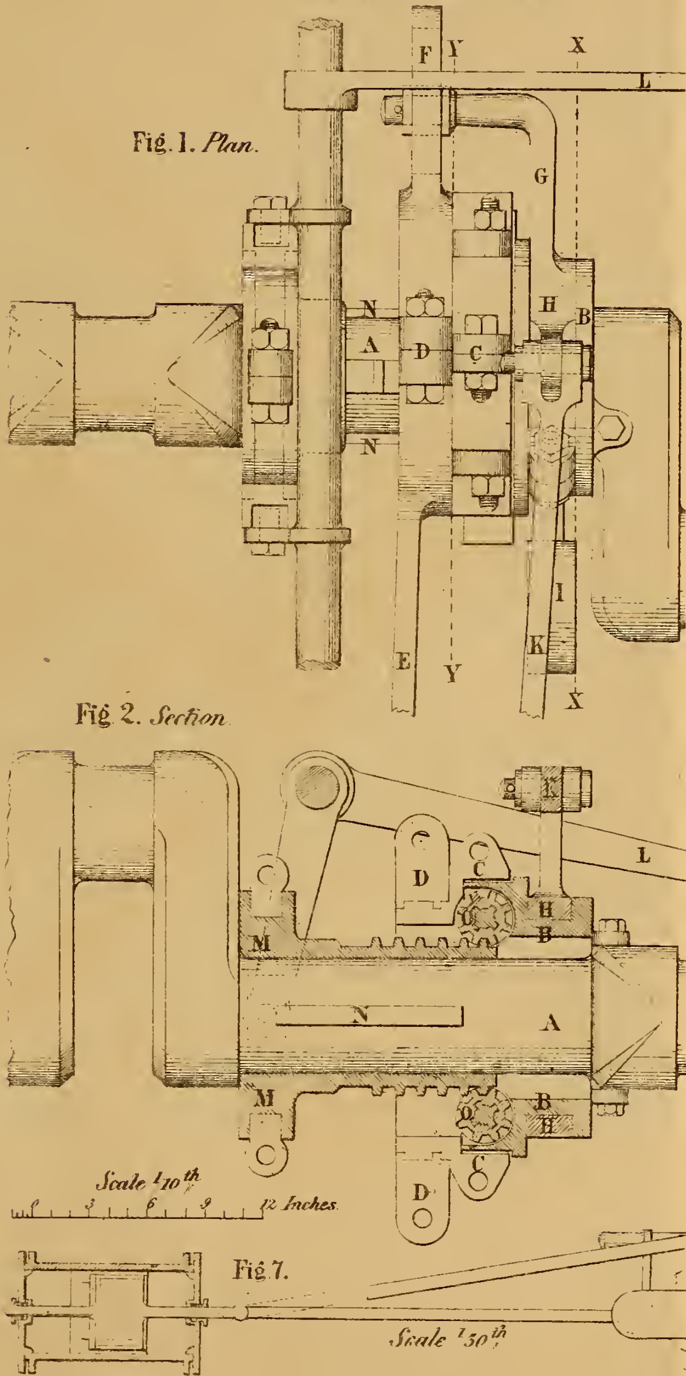
VALVE MOTION.



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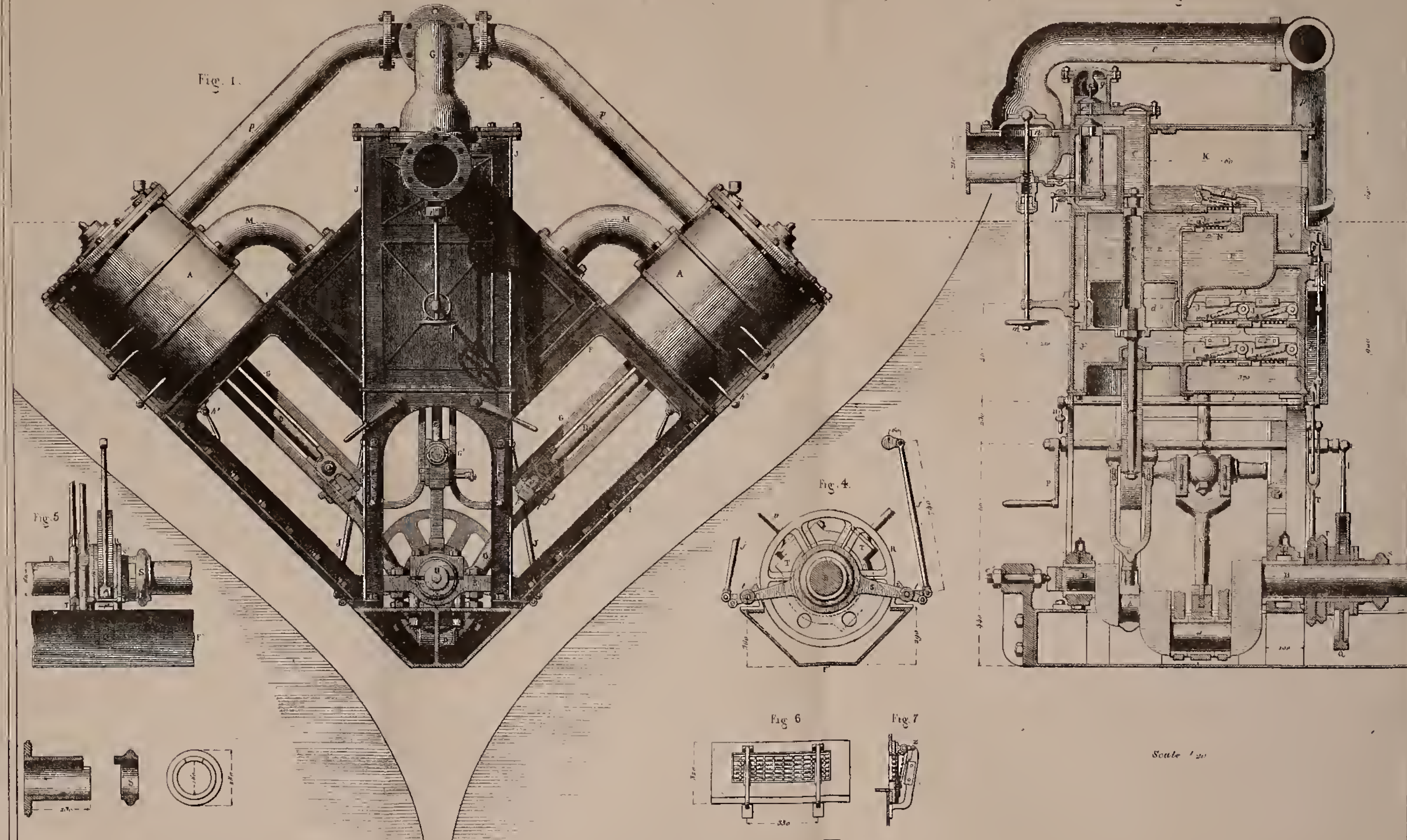
SCREW ENGINES - BY MONS V. GACHE, ENGINEER, NANTES.



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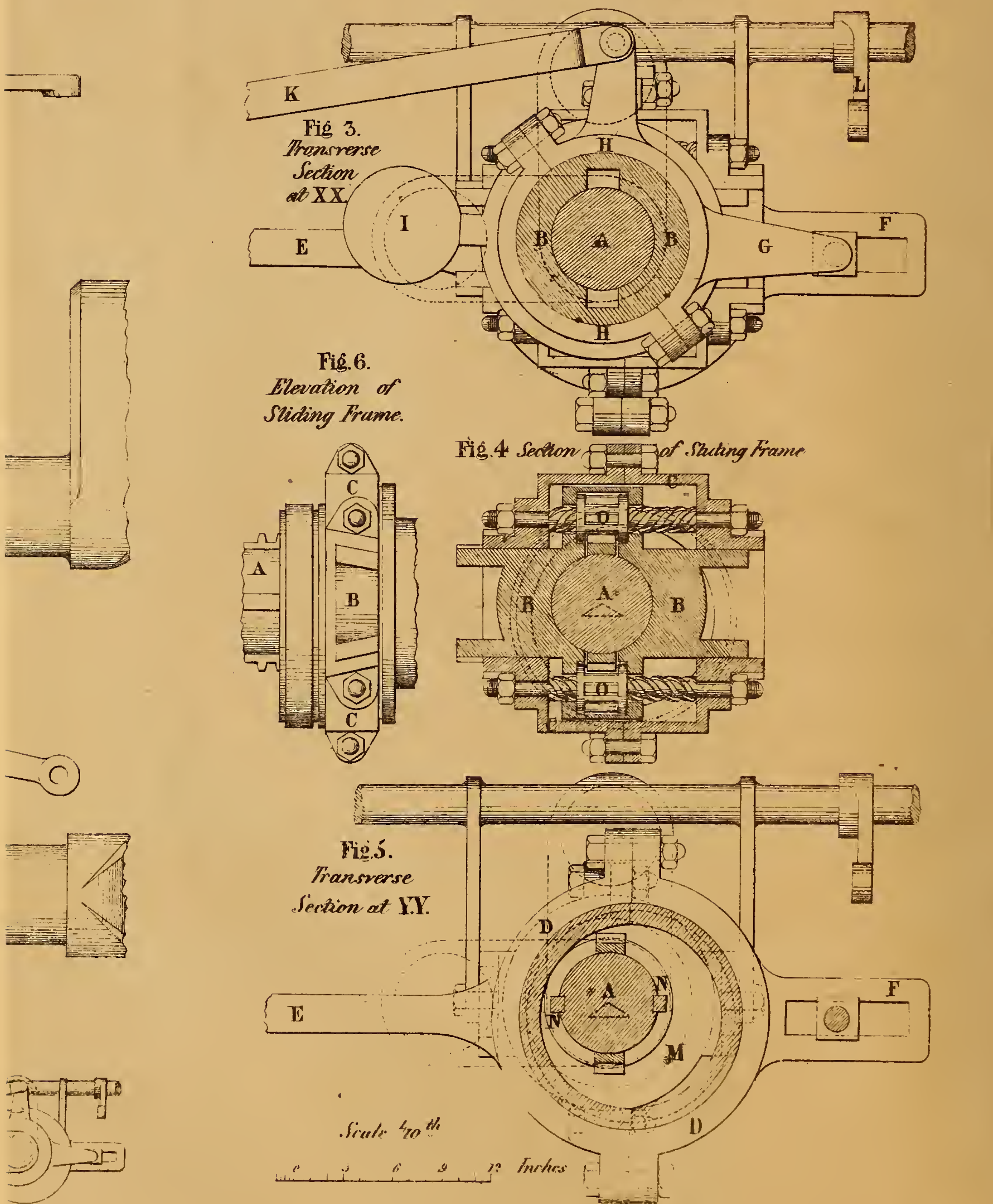


THE ARTIZAN.

No. CLX.—Vol. XIV.—MAY 1st, 1856.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(FROM OUR OWN CORRESPONDENT.)

Southampton, April 17th, 1856.

We have now in the Docks a large fleet of steam ships, the greater part of which have been employed in the late war as Government transports, and most of them are still waiting for orders to proeeed to the Crimea for the re-embarkation of the British forces. Southampton steamers have been largely employed in transport service, but, with one exception, the mail service has not been deranged from this cause, because the reserve vessels have been used to supply deficiencies from the abstraction of the regular mail steamers for transports. The exception mentioned occurred in the suspension of the Australian bimonthly mail between Singapore and Sydney, and it has been a great source of annoyance to the Colonists that this mail should have been discontinued, whilst that to China was uninterrupted. The memorial of the General Assoeiation for the Australian Colonies to the Lords of the Treasury shows that the average passage from London to Melbourne by this route occupied 64 days, whilst under the present system of mail sailing vessels, an average of ten voyages gives 84½ days outwards, and 93½ days homewards, and this, they justly consider, is a disgrace to our Legislature.

They propose that the late route should be resumed as far as Suez, and that a new line of steamers should be formed, consisting of vessels of not less than 2,200 tons burthen, and capable of maintaining an average speed at sea of not less than 10 knots per hour, to proceed direct from Suez to Melbourne, stopping at the Island of Diego Garcia for coal. By this means they contend that the passage from London to Melbourne would only oceupy 44 days, the distance being 10,348 miles, which would give an average speed for the whole route, including all stoppages, of 9·8 knots per hour. We have no doubt at all that this project is quite practicable; but it appears to admit of some doubt as to whether a route from Suez to Melbourne, *viâ* the Mauritius, would not be preferable to that *viâ* the low rocky islaud of Diego Garcia. With regard to the commercial question, it would be necessary that a large subsidy for this mail service should be granted, or otherwise a fleet of such large vessels could not be maintained from the traffic only. The distance between Sucz and Melbourne (7,877 miles) would occupy 33 days actual running. The average consumption of coal per day would certainly not be less than 40 tons;—this would give a total consumption of 1,320 tons, at say, 50s., or £3,300 per voyage for coal only. It is well known that the price of coal in the East Indies sometimes far exceeds 50s. per ton, having a few years back run up to £4, and even more than this. However, we hope to see these questions soon settled, and that Southampton may, before long, again become the port for the Australian mail.

In continuation of our previous notices of some of our steamers, we will now advert to the Peninsular and Orieutal screw steam ship, *Alma*. This fine iron vessel and her sister ship, the *Nubia*, were built by Mr. John Laird, of Birkenhead, the engines by Messrs. Fawcett and Preston, of Liverpool :—

Tonnage, B.M. :—

Length between perpendiculars	291 ft. 7 in.
Breadth extreme	39 ft. 3½ in.
Depth of hold	27 ft. 3½ in.

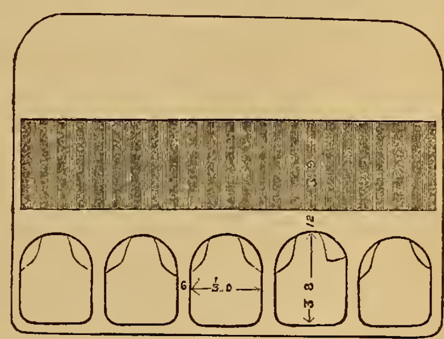
Barque-rigged, elliptical stern, shield figure-head.

Her saloon is beautifully fitted with every luxury that passengers can desire, and as she is intended for the East Indies, a punkah or speeies of enormous fan, worked by the engines and extending its whole length, has been fitted, which will be of great service for ventilation.

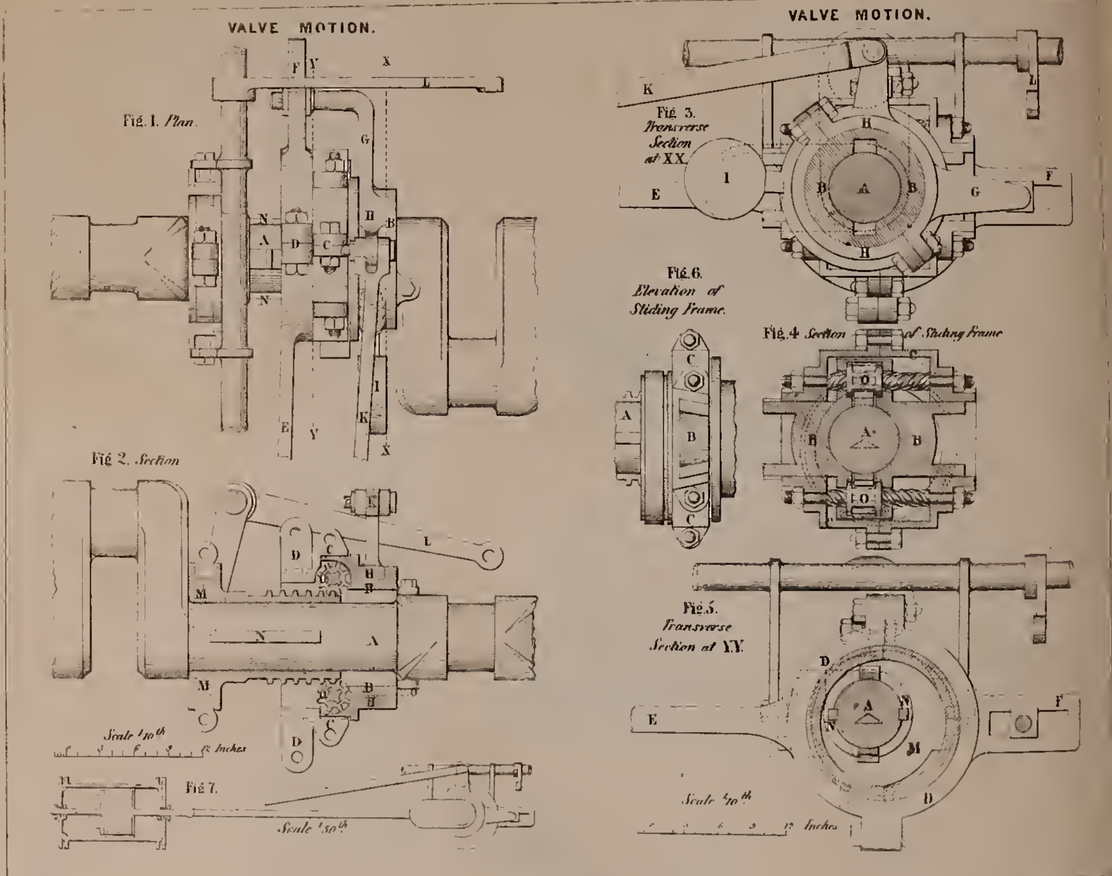
Oscillating geared engines—Diameter of cylinders	78 in.
Stroke of piston	5 ft.
Multiple of gear	2·6
Diameter of screw (2-bladed)	16 ft. 4 in.
Pitch..	21 ft. 6 in.

Trial at measured mile in Stokes' Bay gave a mean speed of 12·1 knots per hour, the engines making 30 revolutious per minute; steam pressure, 15 lb.; vaeuum, 26½ in.; revolutions of screw per minute, 78; slip of screw per eent., 26; mean draught of water, 18 ft. 7½ in.; coal on board, 550 tons. Boilers have Lamb and Summer's patent flues, and supply ample steam for the engines.

She is also fitted with Taylor's Patent Steam Winches, which very useful invention the Peninsular and Oriental Company are now adapting to all their new steamers. They are especially patronised by the Jack Tars, and are usually worked by sailor lads. They hoist cargo in and out of the holds, raise and lower yards and sails, warp the ship when in doek, and, in short, perform all the functions that a very powerful winch can be brought to bear upon, and we think deserve a more particular notice in a future Number of The Artizan.



A rather singular aecideut happened lately to one of the boilers of the *Alma* whilst at sea, and during the night. Owing to the feed-pump valves and non-return valves sticking, or rather not shutting close down in their seats, the water in the boiler was blown out through the feed-pipe, feed-suction, hot-well, and discharge-pipe overboard, and before it was noticed by the engineer on watch, the water had left the flues, and also the upper half of furnaces, dry. The first alarm appears to have been occasioned by the engineer finding no water in the gaugecocks and glass, and when he at once sent for the chief engineer, who, of course, immediately ordered the fires to be drawn. The pressure of steam had, however, before this, forced inwards the erowns and top sides of furnace plates, but without in any way injuring the flues above them. In the sketch the original shape of the furnaces is shown in full lines —the dotted lines showing their form, after being short of water. Ou the arrival of the vessel here, the furnace plates were taken out, straightened, and replaced, and the flues very earefully examined and



W. Smith C.E. direx

found perfect. Since this occurred the vessel has run over 6,000 miles without a leak in the boiler.

We mention this fact as a curious instauce of the apparently trifling and unexpected causes of accidents which sometimes arise with boilers; and also as a proof of the superiority of this description of flue over the ordinary tubes, which, under similar circumstances, would certainly have been injured.

ON STEEP GRADIENTS OF RAILWAYS, AND THE LOCOMOTIVES EMPLOYED.

By Mr. Charles R. Drysdale, Assoc. Inst. C.E.

Abstract of paper read at the Institution of Civil Engineers, April 8, 1856.
Robert Stephenson, Esq., M.P., President, in the Chair.

The object of the Paper was to compare the results of some of the performances of locomotives, of various construction, and of stationary steam-engines working ropes, and also the atmospheric system; to examine these results, and from them to determine the most economical and best manner of effecting the passage of mountain chains by railway lines.

A history of the construction of the Semmering and Giovi Passes was first given, with the nature of the curves, gradients, &c. The locomotives of the Semmering and Giovi were then described. Some English steep inclines were then referred to, and the duties of the Semmering and Giovi engines were compared with the English engines, for evaporating power, for horse-power per cubic foot of water evaporated, and for weight drawn, iu proportion to the weight of locomotive.

After this the duty of the stationary engine on the Edinburgh and Glasgow line was analysed, and the atmospheric incline on the St. Germains Railway.

The "Semmering Railway."—A description was given of some of the most remarkable viaducts aud tunnels of the line.

1. The viaduct of Kalte Rinne, which was composed of two stages, with a gradient of 1 in 80, and a radius of 10 chains 600 ft. long, with an extreme height of 150 ft.

2. The Wagner Graben viaduct had a gradient of 1 in 47; its length was 470 feet, and the greatest height was 127 feet.

3. The Semmering tunnel was 72 chains long; its greatest depth was 374 ft., lined with masonry. The length from Payerbach to Murzzuschleg was 21·52 miles, thus composed:—

	Miles	Gradient.
Payerbach to Eichberg	3·84	of 1·46
Eichberg to Klamm	2·53	„ 1·40
Klamm to Breitenstein	3·26	„ 1·47
Breitenstein to Semmering	3·58	„ 1·54
Semmering to Spital	4·44	„ 1·50
Spital to Murzzuschleg	3·84	„ 1·50

The average gradient of Payerbach to the summit was 1·47 for 13·21 miles. The curvature was very great from Payerbach to Klamm,—about 700 ft. radius. The rails used weighed 88 lbs. to the yard. The engines employed had 75 sq. ft. of firebox surface; 189 tubes 2 in. diameter and 15 ft. 7 in. long = 1,585 sq. ft. heating surface, and 12·6 sq. ft. of grate surface.

The weight of the engine, filled and loaded, was 55¼ tons,—13½ tons on the leading wheels, 12¾ tons on the middle, and 13 tons on the driving wheels. Toothed wheels were afterwards added, and thus all the weight was brought to bear for adhesion. The diameter of the cylinders was 18·7 in., the stroke 25 in., and the diameter of wheels 3 ft. 7⅝ in. Before the toothed wheels were added, to connect the tender to the locomotive, the duty of the engine required by Government was to draw 110 tons up 1 in 40, at 10 miles an hour, consuming less than 144 cubic ft. of dry wood per hour. To perform this, the load on the driving wheels must be at least 8 times the tractive force required, as the condition of the Semmering rails gave no more friction available. Or 8 × 11,040 = 88,320 lbs. (nearly 40 tons) on the driving wheels was required. The resistance of 11,040 lbs. was calculated from the gradient, 1 in 40, giving 56 lbs. per ton due to gravity, and the remaining 13 lbs. was due to speed and traction on the level.

The performance of the engine before adding the toothed wheels was, on a gradient 1 in 40, dead weight = 110 tons, engine and tender = 55¼ tons; the water evaporated per hour (stoppages not included) = 255 cubic ft.; the wood consumed to evaporate this = 3,820 lbs.; the speed = 11·4 miles per hour.

1. This gave 4·15 lbs. of water evaporated per hour by each pound of wood, or 9·6 lbs. water evaporated per sq. ft. of heating surface.

2. As to the H.P., usually represented by the evaporation of 1 cubic ft. water per hour, 165 tons (engine and tender included) at 11·4 miles per hour, drawn up 1 in 40, gave 347 H.P., and 255 cubic feet of water were evaporated;—consequently, ·73 cubic ft. evaporated was equivalent to 1 H.P.

The "Mammoth," Great Western Railway, = 0·76 cubic ft. per H.P. per hour.

The goods engine, No. 227, North Western Railway, = ·675 cubic ft. per H.P. per hour.

3. The proportion that the dead weight bore to the weight of the engine and tender gave the following results:—

The Semmering engine = 4·2 H.P. per ton of engine and tender.
The "Mammoth" = 3·2 H.P. per ton of engine and tender.
The North Western, No. 227 = 3·55 H.P. per ton of engine and tender.

These experiments were brought forward to show that no engine in England would alone work the Semmering traffic. When the hinder wheels were connected with the others, in the Semmering locomotive, the performance rose to 220 tons, up 1 in 40, at 9½ miles per hour, giving, with the engine and tender included, a duty of 380 H.P.; and 165 tons dead weight carried up by 55¼ tons of engine gave $\frac{285}{55{\cdot}25} = 5{\cdot}2$ H.P. exerted per ton of engine and tender.

The mean pressure of steam was 80 lbs.

Lastly, the economical effect stood thus:—44 lbs. of water were evaporated, and 11 lbs. wood were consumed per H.P. per hour, including the engine and tender. Without these:—14·6 lbs. of wood were consumed per H.P. per hour, giving 14·6 to raise 33,000 × 60 lbs., or 1 lb. of wood to raise 13,600 lbs. a foot high; or, again, 82,208 lbs., irrespective of speed.

On the "Giovi" iucline, passing the Apennines, near Genoa, on the Turin and Genoa Railway, the engineer who introduced the working of this line by locomotives had to contend against a strong party, who were in favour of stationary engines.

The "Giovi" incline commenced at 7⅝ miles from Genoa, 295 ft. over the sea, and ascended for 6 miles to an elevation of 1,184 ft. Average gradient 1 in 36.

The length of tunnel = 2·55 miles.
The depth of shaft = 600 ft.
The cost per yard = £118.

Two engines of the same size (built by Messrs. R. Stephenson and Co.,) coupled together and managed by one driver, were used to work the incline. Each carried its own coke and water. The diameter of wheels = 3 ft. 6 in. The cylinders = 14 in., with a stroke = 22 in. The locomotives were bolted together with the fireboxes facing each other, and the driver stood on a common platform. Filled and loaded, the two engines weighed 50 tons.

In fine weather the locomotives took up about 100 tons of load, and in the worst weather never less than 70 tons, at a speed of 15 miles per hour.

The consumption of coke per ton per mile amounted to:—

Not including engine .... 1·94 lbs.
Including .... 1·16 „

The consumption of coke, to draw the engine from the bottom to the top, 6 miles, of 1 in 36, was 8·27 cwts.

1°. The water evaporated, per lb. of coke, was 8·5 lbs.

2°. 150 tons drawn up 1 in 36, at 15 miles per hour, gave a result, with the engine of ... 444 H.P.
and without the engine 295 „

3°. This gave 5·9 tons raised per ton of engine.

4°. 9·7 lb. coke raised 1,980,000 lbs.
Or 1 lb. coke 204,000 lbs. 1 ft. high.
Or, irrespective of speed, 169,600 lbs. „

The Accrington incline was 1 in 41·6 for 2 miles. 71·6 tons were raised at 6·31 miles per hour up the incline. The engine had cylinders 18 in. diameter, 24 in. stroke, 6 coupled wheels of 5 ft. diameter.

The weight of the engine = 26·25 tons.
Tender = 16·75 „
Total = 43·00 tons.

The work done = 74 H.P., which gave 1·7 H.P. raised per ton of the engine and tender.

The Lickey incline had a gradieut of 1 in 37; worked by goods engines, with cylinders 16 in. diameter and 24 in. stroke, and driving wheels 5 ft. diameter, and weighing 32 tons, with an assisting engine whose cylinders = 16 in. and stroke of 24 in., and driving wheels of 4 ft. diameter, weighing 35 tons; together = 67 tons. The results were that 240 tons were drawn up 1 in 37, at a speed of 6½ miles per hour, giving 293 H.P., or 4·4 H.P. exerted per ton of motor.

The Edinburgh and Glasgow Railway incline was stated to be 1¼ mile long, with a gradieut of 1 in 42. During a trial of 23 months, the miles run lifting trains were 21,250½, and the number of ascents = 14,167.

The number of carriages drawn up = 205,181.
The average gross weight per train = 86 tons.
The prime cost of the rope = £1,094.
The coal consumed, per mile, to lift this weight of 86 tons = 527 lbs.
Cost of coal per mile = 11·195d.
The friction of the rope = 1-20th of its weight.
The cost of working the line, including the rope = 50·299d.
The performance was 86 tons drawn up 1 in 42 at 30 miles per hour,

giving 452 H.P. To this was to be added 211 H.P. to move the rope. And 35 lbs. of coal were expended per H.P.

Secondly, without consideration of speed, 1 lb. of coal raised 45,700 lbs. 1 ft. high.

The incline was worked by a wire rope of $4\frac{5}{8}$ in., and on several occasions there had been 30 loaded carriages on each train, and goods trains of 120 tons carried up, without detention.

The total cost of working the incline, for one year, was £734 18s. against £3,204 16s. for locomotives, giving a difference in favour of the stationary engine of £2,460 18s. 9d.

The engines used on the line were probably not well adapted for the traffic, and indeed, for such short inclines, the benefit of stationary engines was very doubtful: there seemed, however, to be some propriety in using them for the passage of long Alpine gradients, as a rope could be made to work a length of 6 miles, and thus steeper gradients might be adopted—even 1 in 25, avoiding thereby great expense in constructing viaducts, &c.

M. Flachât's account of the Atmospheric Railway.—The gradient at the St. Germain's incline was 1 in 33 for the distance of 50 chains, and the total length of the inclination was 1·46 miles, with an average gradient of 1 in 43.

From June 2nd to August 18th, 1855, the number of ascents = 1,413; the weight of carriages lifted = 73,241 tons. The total cost of working, including tallow, engine-men, coal, water, &c. = £612 10s. The cost, per mile, of ascent = 5s. $9\frac{1}{2}$d. The average weight raised per train = 51·8 tons. The cost of coal = 20s. per ton. Economically, leaving speed out of consideration, 1 lb. of coal raised 31,136 lbs. 1 ft. high.

The following summary of results was given :—

Semmering Locomotives.—Total H.P. exerted = 380 H.P.; to lift the train = 285 tons; H.P. per ton of motor = 5·2 tons. Economically (irrespective of speed), 1 lb. wood raised 82,208 lbs. 1 ft. high.

Giovi Locomotives.—Total H.P. exerted = 444 H.P. per ton of motor = 5·9 H.P. Economically (irrespective of speed), 1 lb. coke raised 169,600 lbs. 1 ft. high.

Glasgow Stationary Engine.—Total H.P. to raise the train = 452 H.P., without the H.P. to lift the rope. Economically 1 lb. of slack raised 45,700 lbs. 1 ft. high, irrespective of speed.

St. Germain's Atmospheric System.—1 lb. coal raised 22,063 lbs. 1 ft. high, irrespective of speed.

These results, as compared with the alleged duty of the Cornish boiler, 1,000,000 lbs. 1 ft. high, were still far below laboratory duties.

DESCRIPTION OF A NEW EXPANSIVE VALVE MOTION FOR STEAM-ENGINES.

By Mr. George M. Miller, of Dublin.

Paper read before the Institution of Mechanical Engineers, Birmingham, Oct. 24, 1855. William Fairbairn, Esq., F.R.S., President, in the Chair.

(Illustrated by Plate lxxii).

The object of the valve motion described in the present paper (the invention of Mr. John Wakefield, of the Great Southern and Western Railway, Dublin), is to obtain an expansive action more simple and more perfect than the motion usually employed, the whole motion being obtained from a single eccentric upon the crank shaft.

The general arrangement of this valve motion consists of an eccentric, which, instead of being keyed upon the axle in the ordinary manner, is mounted upon a transverse slide, which is capable of being moved at right angles to the axle by means of a handle that takes the place of the ordinary reversing handle or lever. The effect of moving the transverse slide is to alter the throw of the eccentric or to reverse its position, thereby enabling the valve of the one engine or cylinder to which it belongs to be worked expansively or reversed. The valve of the second engine or cylinder (in the case of the usual pair with cranks at right angles to each other) is worked by a second rod connected with the same eccentric by means of an arm projecting at right angles to the direction of the first eccentric rod, so as to give to both valves a similar motion, but corresponding to the relative position of the two cranks at right angles to each other.

The construction of this apparatus is shown in Plate lxxii, which represents it as applied to a locomotive-engine.

Fig. 1 is a plan of the valve motion.

Fig. 2 is a longitudinal elevation of the axle, showing the valve motion in section.

Figs. 3, 4, and 5, are transverse sections of the axle, showing, in detail, the different portions of which the valve motion is composed.

Fig. 7 is a general view to a smaller scale.

All the figures show the apparatus in the position of full backward gear.

Upon the crank axle, A, and close up against one of the cranks, is fitted a concentric collar, B, fixed to the axle either by keys or by screws tapped into the crank cheek through lugs cast on the collar on the side next the crank. On the other side of the collar are cast two parallel bevelled slides (shown in Fig. 6) situated transversely and equidistant from the centre of the axle. Upon these is fitted a corresponding sliding frame, C, carrying a circular ring cast upon it projecting from its face, which is situated not equidistant between the two parallel slides, but is set eccentrically, that is, nearer to one slide than to the other, by the amount of the minimum throw of the eccentric. The circular ring on the frame, C, thus takes the place of the ordinary eccentric, and is fitted with the eccentric strap, D, on the front edge of which is forged the end of the rod, E, by means of which the spindle of one of the valves is worked. On the back edge of the eccentric strap, and in the same straight line with the eccentric rod, is forged the slotted arm, F, having a horizontal slot fitted with a slide-block. In this is inserted a pin, projecting from the arm, G, of the loose ring, H, concentric with the axle, and working in a groove in the fixed collar, B, previously described. The ring, H, is furnished with a second arm, at right angles to the arm, G, and also with a balance-weight, I. To the second arm is attached a rod, K, similar to the eccentric rod, E, by which the spindle of the second valve is worked.

The transverse section (Fig. 3) shows, in detail, the loose concentric ring, H, on the fixed collar, B, the arm, G, with the projecting pin, and the second arm at right angles to G, with the rod, K, attached; also the balance weight, I, on the opposite side to the arm, G. Fig. 5 shows, in detail, the sliding eccentric ring fitted with the eccentric strap, D, on the back edge of which is the slotted arm, F, with the slide-block.

The reversing action is effected by the lever, L (Fig. 2), which is worked by means of an ordinary reversing handle. The lever, L, is attached to a loose strap or clutch fitting in a groove in the collar, M, which is free to slide along the axle, but is caused to revolve with it by means of the two feathers, N, N, Fig. 5. The collar, M, carries two racks, which drive the two pinions, O, O, Fig. 4. These pinions are screwed internally to fit on two large four-threaded screws, which are secured in the sliding frame, C, previously described. The pinions, O, O, are placed in cavities in the fixed collar, B, and thus are incapable of any lateral motion. In reversing the engine the collar, M, is caused to slide along the axle by means of the lever, L, and the racks cause the pinions, O, O, to rotate; the screws being held in the sliding frame, C, so as to be incapable of turning, a transverse motion is communicated to the frame, which, with the eccentric ring attached to it, is carried along the parallel slides, thus reversing the position of the eccentricity. The reversing lever is moved with greater facility than is usually the case with the link motion.

When the eccentric ring is giving the greatest horizontal motion to the eccentric rod, E, the slotted arm, F, has its least vertical motion, and, consequently, since it is the vertical motion alone of the slot which affects the arm, G, the latter is at this time stationary, and therefore the arm at right angles to it is also stationary, and the rod, K, has no horizontal motion. In like manner, when the eccentric rod, E, has no horizontal motion, it has the greatest vertical motion, as also has the slot, F, and this, being communicated through the right-angled arms of the ring, H, causes the rod, K, to have its greatest horizontal motion.

It has to be observed that with this motion the engine can never be thrown entirely out of gear. When the engine is reversed, the centre of the eccentric describes a *chord* line (Figs. 4 and 5), not the *diameter* of the circle of eccentricity, and, consequently, the minimum to which the throw can be reduced is the distance of this chord line from the centre of the axle, or the sum of the lead and lap of the slide; but the same circumstance applies to the ordinary link motion, and although, for this reason, the expansive action of the steam cannot be extended indefinitely, yet, practically, this is no objection to the valve motion, since between the positions of maximum and minimum throw it admits of as great a range for the application of the expansive principle as can be made practically available where the link motion is employed.

In the new valve motion the lead is constant for all positions of gear, whilst in the ordinary or shifting link motion it varies to a certain extent with every change of position, increasing as the throw of the valve diminishes; in the new valve motion, accordingly, the expansive action alone is altered by regulating the amount of throw, whilst the lead is not affected by the change.

A modification of the above valve motion is applicable to stationary and marine engines, in which a bell-crank lever is introduced for the purpose of giving the motion to the second valve-rod in a position parallel to the first, instead of an inclined position, as before described; see the rod, K, Fig. 3.

The simplest arrangement would be to have the two cylinders placed at right angles to each other, working upon the same crank-pin; in this case the two valve-rods would be worked direct by the one eccentric, their direction at right angles to each other obviating the necessity for the intermediate arms or levers introduced in the former arrangements.

A practical trial of this valve motion has been made in two locomotive-engines on the Great Southern and Western Railway, which have been working with it one year and a half and one year and a quarter since March and July, 1854.

One of these, a passenger engine, is fitted with the new motion, as shown in the drawings and model. In the other, a goods engine, a slight modification has been made, the construction being simplified by dispensing with the slotted arm, F, projecting from the back edge of the eccentric strap, D, and substituting a similar slot in the eccentric rod, E; the arm, G, of the loose concentric ring, H, is thus brought round to the front, and the balance-weight, I, is placed behind.

The passenger engine (No. 9) has 15 in. cylinders with a 20 in. stroke, and 5 ft. 6 in. driving-wheels; it has been working regularly between Dublin and Thurles (a distance of 87 miles), with two other engines (Nos. 17 and 19) by the same maker, and similar in all respects, except that they are furnished with the ordinary link motion.

The results of the working of these three engines during the year and a half, from the 18th March, 1854, to 12th October, 1855, are as follows:—

	Miles run.	Coke per mile. lbs.	Average load. Carriages.
No. 9	44,450	20·3	6·0
No. 17	42,741	23·6	5·9
No. 19	27,194	24·9	5·8
Mean with link motion		24·25	5·85
Mean with new valve motion		20·03	6·00

The carriages are six-wheeled, and weigh 7 tons empty.

A comparison of the results of the performance of these engines for the periods before stated shows an average saving in consumption of coke of $4\frac{1}{4}$ lbs. per mile, or $17\frac{1}{2}$ per cent. in favour of the engine having the new valve motion.

The goods engine (No. 53) has worked well, but the variable character of the work assigned to the goods engines on the above line renders it difficult to compare their performance.

It will be observed that the first engine (No. 9, passenger engine) fitted with the new valve motion, has now had it more than a year and a half in constant work. The motion has undergone no repair during the whole time, except that a thin lining of white metal has been recently put upon the face of the bevelled slides, which had worn a little slack, having been in the first instance made of brass. In the subsequent engines cast-iron has been used for these slides. No other repair to the motion has been needed, and it is still working in good order.

The second engine (No. 53, goods engine) has been more than one year and a quarter in constant work with the new valve motion, and has run during that time 23,581 miles; this motion has had no repairs, and has never even been taken to pieces and examined since first got to work until a fortnight ago, and when the parts were then detached for inspection they were found in excellent condition, the working faces all in good order, the teeth of the racks and pinions showing no signs of wear, and the whole play of the apparatus amounting to only about $\frac{1}{16}$th of an inch, being little more than it had when originally set to work. This motion seems likely to work for more than the usual time before needing repairs, and the small amount of wear in it is remarkable as compared with the ordinary link motion, which appears to arise from the large extent of rubbing surface, and the fact that the whole is held firmly between side cheeks and steadied by them whilst in motion; the working parts are also enclosed and protected from dust.

It may be thought that the application of this new motion encumbers the crank axle with more complex machinery than is the case when four eccentrics are used; but it must, on the other hand, be observed that the remainder of the space under the boiler is left more free for examination and cleaning; also, the eccentric rods have at all times only the same extent of motion as the valves, whilst with the link motion most of the working parts reciprocate over the same space, whether the engine be working expansively or not.

Mr. Miller exhibited a working model of the new valve motion, showing it as applied to a locomotive-engine.

The Chairman observed that the subject of the paper was one of importance, and from the particulars given the new motion appeared to have some advantage in durability and working; the comparative saving of fuel stated in the paper was considerable, but might, probably, be partly owing to other causes than the new motion alone. He had seen the motion about twelve months ago on an engine upon the railway at Dublin, but it had then been only a few months at work, so that the results of the working had not been sufficiently ascertained. He inquired whether any more engines had been furnished with the new motion, besides the two mentioned in the paper, and whether any further particulars of the working had been obtained.

Mr. Miller replied that it had been applied to three more engines on the Great Southern and Western Railway, but these had been at work only a few weeks, and, consequently, no results had yet been obtained. It had also been tried by Mr. Stephenson in an engine made for the North Eastern Railway about three month ago. The great saving of fuel which had been stated in the paper was, he believed, correctly ascertained, but he was at a loss to account for so great a saving from the valve motion alone; he could suppose only that it arose from the circumstance that there were fewer joints in the new motion, causing less loss from play after wear than in the link motion. The movement imparted to the valves was not quite the same as in the link motion, and he considered that it was more correct than that given by the link, on account of the lead remaining the same; there was some difficulty in getting the link motion to work truly in all positions of gear, and the greater exactness with which the new motion worked in the different degrees of expansion might partly explain the economy effected with it. In the engine from which the results in the paper had been taken, the steam had been cut off to the same extent as in the corresponding engine with the link motion, the lap of the valve being $\frac{9}{16}$ths in., and the lead 1-4th in. He intended to take some indicator diagrams from the engines fitted with the new motion, and these would show distinctly what difference there was between its action and that of the ordinary link motion.

The Chairman said it was important that some indicator figures should be taken for the purpose of comparison; that was, indeed, the only method of satisfactorily examining the working of the new motion. He asked whether the new motion was applicable to any kind of engine.

Mr. Miller answered that it might be adapted to any engine, and a form applicable to marine engines was shown in the drawings; but it had been tried at present only for locomotives.

Mr. Cowper did not see how there could be any material difference in the working of the valves from that given by the link motion, as in the latter the lead was nearly constant. He thought the saving of fuel with the new motion, as far as it arose from diminished play in the valve gear, could be only small in amount; it must be due mainly to improved construction of the machinery in general, or to working one engine more expansively than the other, or to greater care on the part of the engine-driver to economise fuel, as a great difference was often found in the economy of an engine when worked by different men.

Mr. Miller said that the circumstances in which the two engines had been placed, from which the comparative results had been obtained, had been as nearly alike as possible; their age and general condition were the same, and he believed they had been worked to the same degree of expansion and with the same care in both cases.

Mr. Ramsbottom thought that the action of the new motion was nearly the same as that of Dodds' wedge motion, and differed so little from that of the link motion, that its superiority would be mainly a question of durability and maintenance, which could be decided only by long experience. In the link motion the lead became greater at a higher degree of expansion, but he did not consider this objectionable, but rather an advantage, as the greater lead was used principally for higher speeds. The arrangement of the new motion was ingenious, but he should fear the maintenance of it would involve an increase of expense.

Mr. Miller said that the cost of maintenance had been found to be but little, and appeared to be decidedly less than with the link motion; the first engine had only had a lining of white metal put on the face of the bevel-slides during the whole year and a half that it had been at work, and nothing at all had been done to the other during the year and a quarter that it had been at work; whereas an ordinary link motion would have been much worn and have required considerable repair by that time. The difficulty with the wedge motion, arising from the objectionable strain thrown on the slides of the eccentric and on the wedge surfaces, did not exist in the new motion; the screws and pinions, which were the parts that had the greatest appearance of complication, were not exposed to any strain or work while the engine was running, and were moved only when it was required to reverse the engine or alter the degree of expansion; this circumstance alone would tend to greater durability.

Mr. Fernie observed that the new motion appeared to him more complicated than the wedge motion, and he feared would be inferior to it, having a greater number of joints. He had had some experience of the latter on the Midland Railway, where four or five engines were running with it; there was a difficulty in keeping the motion in working order, and it had not proved any better than the link motion.

The Secretary mentioned that he had recently had an opportunity of examining the new motion at work, and had seen it at the time of being taken to pieces for the first time, as had been stated; there was not any appearance of wear in the teeth of the racks and pinions, nor in any other parts, though they had been in use for so long a time; the motion appeared to work well, and it was easy to reverse or alter the expansion.

The Chairman said he hoped that the action of the new motion would be investigated by means of indicator diagrams, so as to ascertain clearly its merits, and they would be glad to hear the further results.

He proposed a vote of thanks to Mr. Miller for his paper, which was passed.

CIVIL ENGINEERING.*

METHOD OF CALCULATING EXCAVATION AND EMBANKMENT.

By George A. Simonson, *Polytechnic College of Pa.*

The shortest way of making these calculations is by the aid of diagrams invented by Mr. J. C. Trautwine, Civil Engineer. But as the engineer is sometimes required to estimate earth-work, when these diagrams are not in his possession, and as the shortest rule at present employed which will give accurate results is the prismoidal formula, which is certainly very tedious, it is expedient that a shorter equation for the solidity be prepared.

After finding the end areas, according to the usual rule, *i. e.*, multiply the extreme horizontal width by half the centre cutting, and add the product to 1-4th the width of the roadway into the sum of the outside cuttings; we can find an expression for the solidity in terms of these areas, the width of the roadway and the slope of the bank. The following equation, original with me, I believe to be as simple as any. Denote the greater area by A, and the lesser by a. Express the length of the embankment or excavation by L, the depth of the greater cut by C, and that of the lesser by c. C and c are the cuttings of level cross-sections having the same areas respectively, A and a, as the sections under consideration. Denote the horizontal width, or the distance between the two slope stakes of a level excavation whose depth is equal to C by W, and the horizontal width corresponding to c by w. Let R equal the width of roadway, and s the horizontal distance for a unit of height in the slope, and finally, let S stand for the solidity; then the expression deduced for S is

$$S = \frac{L}{3}\left(2a + A + \frac{A - a}{\sqrt{\frac{4As + R^2}{4as + R^2}} + 1}\right)$$

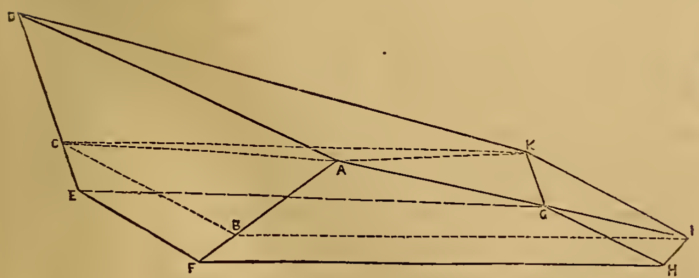
The expression by the prismoidal formula is

$$S = \frac{L}{6}\left(A + a + 4\left(\frac{3}{2}\,\frac{\left(\sqrt{\frac{2A}{3} + \left(\frac{R}{3}\right)^2}\right) - \frac{R}{3} + \sqrt{\frac{2a}{3} + \left(\frac{R}{3}\right)^2} - \frac{R}{3}}{2} + R\right) \times \left(\frac{\sqrt{\frac{2A}{3} + \left(\frac{R}{3}\right)^2} + \sqrt{\frac{2a}{3} + \left(\frac{R}{3}\right)^2} - \frac{2R}{3}}{2}\right)\right)$$

when the slope is $1\frac{1}{2}$ to 1, or that most generally used, and for any slope.

$$S = \frac{L}{6}\left(A + a + 4\left(s\,\frac{\sqrt{\frac{A}{s} + \left(\frac{R}{2s}\right)^2} + \sqrt{\frac{a}{s} + \left(\frac{R}{2s}\right)^2} - \frac{R}{s}}{2} + R\right) \times \left(\frac{\sqrt{\frac{A}{s} + \left(\frac{R}{2s}\right)^2} + \sqrt{\frac{a}{s} + \left(\frac{R}{2s}\right)^2} - \frac{R}{s}}{2}\right)\right)$$

It will be seen that the first equation is much shorter than the prismoidal formula. Let us now consider its demonstration



Let A D E F represent the cross-section of a level cutting, C, equal A, and G H I K G that of a cutting, c, equal a. The solidity in practice is considered equal to that of a regular prismoid whose end areas and length are equal to any irregular one under consideration. This, however, is not strictly true, because the surface of the ground excavated will usually be more or less warped. When very much warped, intermediate cross-sections between two stations must be taken. Under the supposition that the irregular solid is equivalent to the regular prismoid in the figure, let us find its solidity.

Make F B = H I and C E = G K, join B and C, B and I, and C and K. The solidity of the prism thus formed of which each of the end areas equals a, and the length of which is the length of the whole solid equals $a \times L$. Draw A C and A K forming the rectangular pyramid whose vertex is at A, and whose base is B C K I $= w \times L$. Now the altitude of this pyramid is C — c, hence its solidity $= w \times L\,\frac{C - c}{3}$. There remains the triangular pyramid whose base is A C D and whose altitude is the length of the prismoid, because its vertex is at K. Its solidity $= \frac{W \times (C - c)}{2} \times \frac{L}{3}$. But the prismoid is made up of the prism and the two pyramids, hence we may write for its solidity,

$S = a\,L + \frac{w\,L\,(C - c)}{3} + \frac{W \times (C - c)\,L}{6}$, or as L is a common factor,

$S = L\left(a + \left(w + \frac{W}{2}\right)\left(\frac{C - c}{3}\right)\right)$, or by bringing w and W to a common denominator

$$S = L\left(a + \frac{2w + W}{2}\,\frac{C - c}{3}\right) = L\left(a + \frac{2Cw + CW - 2cw - cW}{6}\right).$$

But $A - a = ABCD = \frac{W + w}{2}(C - c)$ or $2A - 2a = Cw + CW - cw - cW$; now, by adding $Cw - cw$ to each side of this equation, there results $2A - 2a + Cw - cw = 2Cw + CW - 2cw - cW$. Substituting this value in the last equation for the solidity, and bringing a into the numerator, we obtain

$$S = L\left(\frac{4a + 2A + Cw - cw}{6}\right)$$

but $\frac{W + w}{2}(C - c) = A - a$, or $C - c = \frac{2A - 2a}{W + w}$. By multiplying both members of the last equation by w we get

$Cw - cw = \frac{w}{W + w}(2A - 2a)$; substituting this value in the last equation for the solidity, we obtain

$$S = \frac{L}{3}\left(2a + A + \frac{w}{W + w}(A - a)\right) \text{ or } S = \frac{L}{3}\left(2a + A + \frac{A - a}{\frac{W}{w} + 1}\right).$$

Let us now find a value for the widths in terms of the areas, slope, and roadway. We have first $\frac{W + R}{2}C = A$ because A D E F is a trapezoid. But $C = \frac{W - R}{2s}$; therefore, $\frac{W^2 - R^2}{4s} = A$, or $W = \sqrt{4As + R^2}$; in like manner we should find $w = \sqrt{4as + R^2}$, and substituting these values in the last formula for the solidity, we obtain

$$S = \frac{L}{3}\left(2a + A + \frac{A - a}{\sqrt{\frac{4As + R^2}{4As + R^2}} + 1}\right) \text{ as previously given.}$$

This formula will apply to embankments, because an embankment presents the same figure as an inverted excavation.

Example.—In the first cross-section let the centre cut be 3 feet, the right cut 2 feet, and the left cut 5 feet. In the second, let the centre cut be 2 feet, the right cut 1 foot, and the left cut 4 feet. Required the solidity when the width of the roadway is 20 feet, the slopes $1\frac{1}{2}$ to 1, and the distance between the sections 100 feet.

$$\text{Here } A = (1\tfrac{1}{2} \times 5 + 1\tfrac{1}{2} \times 2 + 20) \times 1{\cdot}5 + (5 + 2)\frac{20}{4}\Big) = 80{\cdot}75,$$

$$a = (1\tfrac{1}{2} \times 4 + 1\tfrac{1}{2} \times 1 + 20) \times 1 + 5\,(4 + 1) = 52{\cdot}5, \text{ and}$$

$$S = \frac{100}{3}\left(2 \times 52{\cdot}5 + 80{\cdot}75 + \frac{80{\cdot}75 - 52{\cdot}5}{\sqrt{\frac{4 \times 80{\cdot}75 \times 1\frac{1}{2} + 20^2}{4 \times 52{\cdot}5 \times 1\frac{1}{2} + 20^2}} + 1}\right)$$

$$S = \frac{100}{3}\left(185{\cdot}75 + \frac{28{\cdot}25}{\sqrt{1{\cdot}237063} + 1}\right) = \frac{100}{3}\left(185{\cdot}75 + \frac{28{\cdot}25}{2{\cdot}1122}\right) = \frac{19912{\cdot}5}{3} =$$

6637·5 cubic feet = 245·8 cubic yards.

* From the "Journal of the Franklin Institute."

By the prismoidal formula we find from the areas a cutting of an equivalent level cross-section by the formula

$$C = \sqrt{\frac{A}{S} + \left(\frac{R}{2s}\right)^2} - \frac{R}{2s} \text{ or } C = \sqrt{\frac{80\cdot75}{1\frac{1}{2}} + \left(\frac{20}{3}\right)^2} - \frac{20}{3} = 3\cdot24686$$

and $c = \sqrt{\frac{52\cdot5}{1\frac{1}{2}} + \left(\frac{20}{3}\right)^2} - \frac{20}{3} = 2\cdot24654$, and $\frac{3\cdot24686 + 2\cdot24654}{2} =$ 2·7467, the middle cut. For the area corresponding to this cut we have $\left(\frac{2\cdot7467 \times 3}{2} + 20\right) 2\cdot7467 = 66\cdot2504$, and by the prismoidal formula we have $S = \frac{100}{6}(4 \times 66\cdot2504 + 80\cdot75 + 52\cdot5) = 6637\cdot5$ cubic feet = 245·8 cubic yards.

EAST INDIAN RAILWAYS.

On the 9th of April a large party of professional friends and gentlemen, representing almost every branch of railway construction, invited Mr. James Berkley, the Chief Resident Engineer of the Great Indian Peninsular Railway Company, to a sumptuous entertainment at the Albion, to do honour to his past services in India, and to bid him farewell before returning to his arduous post. The party consisted of Robert Stephenson, Esq., M.P. (President of the Institution of Civil Engineers), Sir S. Morton Peto, Messrs. C. Nicholson, G. P. Bidder, Fowler, Hawksley, McClean, Yarrow, Borthwick, G. R. Stephenson, G. Berkley, W. Bird, Beale, W. A. Matthews, C. Manby (Secretary Inst. C.E.), E. Clark, Alleu Ransome, Robinson, Swann, W. Bevan, Lloyd, Ashbury, C. C. Williams, Kitson, Hamilton, Richardson, Burt, &c., many of whom had travelled from distant parts of the country to be present on the occasion.

The Chair was excellently filled by Robert Stephenson, Esq., M.P., with W. Bird, Esq., one of the earliest and most strenuous supporters of Indian and Continental railways, for the Vice-President. It will be seen that the proceedings were of a very interesting and animated character, and the entertainment may be viewed as a worthy tribute to one of those successful and enterprising engineers, who has taken the lead in working out the Indian Railway system, as well as a strong indication of the general interest which now prevails in England respectiug those important undertakings; as secure and profitable investments they have gradually risen in public estimation, and are now regarded not only as great public works, destined to open out the commerce and riches of our Indian Empire, but also as a wide field for the employment of engineering and practical skill, and one of the largest markets for British manufactures. The speeches were excellent, and the Chairman—that most eminent authority upon railway subjects—while eulogising the achievements of their guest, Mr. Berkley, in having constructed and opened the first railway in India, and in having so successfully combated the difficulties of the Ghauts, did not forget to add a few words of very excellent advice. With Mr. Stephenson, we would express our hopes that the Indian Government will foster and protect these fine projects, which owe their origin in a great measure to their early encouragement, and from which they, as well as the country under their rule, must reap plenteous reward.

The cloth having been removed, Mr. Stephenson rose and said:—Gentlemen,—I have very sincere pleasure in presiding at this entertainment, which is offered to my friend Mr. James Berkley. I feel that on the present occasion it is not necessary to enlarge upon the professional acquirements or talents, or the social virtues of my friend, for he has already prominently brought himself to your notice by his professional abilities under exceedingly trying and adverse circumstances, and by the esteem in which he is held by all who know him—(Cheers). Very early in his life, and when I was tolerably advanced in my career, he was introduced to my notice as a young and professionally inexperienced man, but a very short acquaintance and association with him convinced me that he was possessed of a good heart and a good head—(hear, hear)—and in a short time he became not only confidently associated with me in professional life, but my intimate friend in my domestic circle. I freely imparted to him my own views and opinions, and employed him in the construction of several of the principal lines entrusted to me—(Cheers). When the opportunity for his going to India presented itself, felt that he had embarked in an exceedingly difficult task. Having myself been thrown in early life upon my own resources in a foreign country, where engineering operations were of a very difficult character, I well knew the variety and nature of the obstacles he would have to encounter; aud you will readily comprehend how operations, even such as are easy in this country, would become extremely arduous when undertaken abroad. The Directors of the Railway Company were influenced by my recommendation, strengthened as it was by the highest testimonials, and my friend went to India, where he has amply justified the opinion I had formed of his capabilities, and has successfully overcome numerous difficulties and impediments of no ordinary character. A favourite expression of my father's, in his early career, was—"I can engineer matter very well, but my great difficulty is in engineering men." Mr. Berkley has, I am happy to say, succeeded not only in engineering matter in a foreign country, with few available resources for railway operations, but he has also been eminently successful in that more difficult task of engineering men. No small tribute to his talents and his temper.

It is scarcely necessary for me to do more than allude briefly to the works executed by our guest during his comparatively short stay in India. He has already executed 90 miles of railway which are on the point of being opened, as far as the Ghauts, the great physical feature of the West of India. The questiou of the ascents of the Ghauts is one of considerable difficulty, and demanding much knowledge, skill, and consideration. Excellent desigus of them have, however, been prepared by Mr. Berkley, and the explanations he has afforded me are so minute and interesting, that I assure you I should feel proud of being the author of the plans he has proposed. Throughout these operations he has encountered all the formidable obstacles which the Ghauts present, and has overcome them with remarkable success. And this redounds all the more to his credit, when we consider that the Ghauts present greater engineering difficulties than either the passage of the Semmering to Trieste, or the Giovi incline between Turin and Genoa; and that the ascent of those mountains was long considered barely practicable. Although those mountain inclines are serious undertakings, it is compulsory for the good of the country to make and to maintain them; and in spite of all difficulties, Mr. Berkley has, after six years of laborious research, succeeded in designing a series of lines, which I have no doubt will be amongst the most successful in the world. I trust, however, that greater wisdom will be displayed by the Indian Government than by our Home Legislature in that respect. That they will be watched over with something more like parental care, for here they have been deserted like prodigal sons. India demands accommodation for an enormous traffic and population, and if the railways are permitted to be extended with discretion and wisdom, there cannot be a question that they will be both beneficial to those who have invested capital in the enterprise, and of incalculable advantage to that important country—(Hear, hear). My friend at my side has also the honour, whether accidental or not, of being the engineer who constructed and opened the first railway in India. This is no small credit to him, and in all that he has done I feel proud of him, and that he has reflected honour upon my recommendation.

Mr. James Berkley said—I most sincerely thank you all, both for the entertainment and for your good wishes. The compliment is doubly acceptable to me, because I well know that it is intended not only as a mark of personal esteem to myself, but as a testimony of the lively interest which you all take in the important undertaking in India with which I have the honour to be connected. It is indeed a great responsibility to be one of the pioneers of railway enterprise in India, and to be conscious that upon one's owu care and judgment in its early operations may, in a great measure, depend the successful applicatiou of English engineering experieuce, and not only the progress, but the ultimate triumph of railway communications in India, which are now universally admitted to be destined, more thau any other innovation, to promote the material welfare of its immeuse population. It has always appeared to me a remarkable fact that railways, which the iuventive genius and bold enterprise of a great man bestowed upon the greatest commerce in the world, to facilitate and extend its transactious, should be introduced into India as an entirely new agent to lift, as may be said, with one powerful grasp, the rude mass of its people from poverty and degradation to enlightenment and prosperity. With regard to my assistants, they were nearly all expressly chosen by Mr. Stephenson. My native assistants and draughtsmen are clever and industrious, and I do believe that a better staff of engineers was seldom, if ever, collected together. I have been blessed, thanks to Providence, with excellent health during six years, although I have, from time to time, been very much exposed, and duriug the hot seasons I have had to roam about iu tents to explore the Ghauts. I found, wheu I went to the country, that the materials were unexceptionable; whilst labour was cheap and abundant, and very much better than I expected. Our miners, masons, and bricklayers are really very good artizans; and all classes of labourers have shown that, with care and painstaking, they are susceptible of very marked and rapid improvemeut. It was perfectly obvious to me that substantially our operations depended upon native labour. I therefore made it my study to conciliate them, and to impress upon my assistants and inspectors the importance of always treatiug them with kindness and patience. The result of this system has been most successful. We have an extraordinary command of native favour; and although it has been over and over again predicted that the works upon our extensions would be retarded for waut of hands to execute them, it is a fact that Mr. Faviell, who commenced operations in Jauuary, was on the 6th March employing as many as 15,000 men upon only 45 miles of line. With all these advantages you will easily conceive that I have had some difficulties and embarrassments to contend with. When I first went to India I found a strong prejudice existing in labour of what was called the departmental system, which was that adopted by the Government for the construction of public works. I saw at once that such a system was incompatible with the efficient construction of railways. In the first place I noticed that the division of labour was nearly ignored, notwithstanding the example of English practice,—notwithstanding that it formed some of the caste distinctions of the native population; I found that all the various duties connected with public works were thrown upon individual officers, so that by making them the executors as well as the designers and superintendents of the work, they deprived the country of the services of a class of honourable men—a class which is foremost in enterprising and in practical experience—and without whose co-operation I believe that many of our noblest works would never have been carried out,—I mean the contractors of England. I at once determined that as far as it rested in me, my share of the railways of Western India should be constructed by the agency of contractors, for I well knew that by such a measure our project would be benefited by the assistance of experienced and responsible men, by economical management, and by the best mechanical appliances, and also that the native labourers would be rendered more efficient by the training and example of the best foremen of works; and in the operations both of our European and Native contractors, I have had every reason to feel that I was right. All official difficulties are now, I am happy to say, overcome. We have the most suitable Government Officer in Western India to supervise our proceedings, and the Government and the Railway Company are earnestly bent upon one common object.

Let me now turn to more important matters of fact. We have laid out 1,450 miles of main line in India, the whole of which extent has been sanctioned by the British Government, and 800 miles, including the Ghaut inclines, have been conceded to the Peninsular Railway Company for immediate construction. We have, I may say, finished 90 miles of railway, and 220 miles more are actively progressing. Notwithstanding the magnitude of these operations, I feel perfectly sanguine of ultimate success.

Mr. C. Nicholson said—Mr. Berkley went out, as he himself stated, about six years ago, to lay down and construct what was called "an experimental railway" of 30 miles long. Therefore, both the railway and the engineer were experimental, and it argues the possession of much skill to be able now to say, that both the project and the officer have entirely and in every respect proved eminently successful. Our officer has been tried in the furnace, and he is now going out again to India to lay down and construct not 30 but 1,300 or 1,400 miles of railway; and if God should spare his health he will succeed in constructing that portion of railway and in bringing it to a successful issue before he returns to his native land, crowned with well-earned laurels. What will be the effect of the construction by our Company of 1,300 or 1,400 miles of railway, of a corresponding length of railway by the East India Railway Company, of a considerable extent of railway by Mr. Yarrow for the Scinde Company, and by two other companies—five several companies in India laying down from 5,000 to 10,000 miles of railway within the next seven years? I will ask you, can imagination conceive what will be the moral effect in India of such an innovation? It will break down all the prejudices, all the castes, and all those systems in that country which keep that portion of the human race from being on a level with the rest of the human species. The motto of our railway is:—"*Arte non Ense.*" The conquest of the country of Hindostan was by the sword, but I will venture to say that the conquest of the Hindoos, as a people, will be by the railways—and by those acts which the railway system invariably introduces. When we have familiarised the people with civilisation, which the railway carries along with it, we shall have obtained their sympathy and their confidence, and have exalted them in the human family. There are not less than 150,000,000 of British subjects in India, all anxious, all ready to give to this country the fruits of the most productive soil under the sun, and ready to take in return those products which you, Gentlemen, among others, are manufacturing every day, and which will be exported to India to such an extent, that I hesitate not to say that in a very few years you will all be ready to exclaim with truth, that India is the best customer of this country. Mr. Nicholson, after passing a high encomium on the abilities, talents, and character of the President, asked the company to join with him in drinking the health of Mr. R. Stephenson, and long life to him.

NOTES BY A PRACTICAL CHEMIST.

Detection of Sulphurous Acid in Hops.—Hops are frequently treated with sulphurous acid whilst drying, the fumes of 1 lb. of burning sulphur being applied to 2 cwt. of hops. To detect this, Wagner places in a beaker nitro-prusside of sodium, so dilute as to appear of a pale brown colour, adding a few drops of solution of caustic potash. The sample of hops to be examined is placed in a flask with a little granulated zinc, and drenched with dilute hydrochloric acid, the gas being passed into the beaker. If any sulphur is present a splendid violet colour makes its appearance. The same process will serve to detect sulphur in wines, silk, and other organic matters.

Detection of Alum in Red Wines.—Pure red wines are not rendered turbid even on prolonged boiling. If, however, alum be present, a flocculent precipitate will gradually form, and subside to the bottom of the vessel on cooling. This is a compound of alumina, derived from the decomposition of the alum, with the colouring matter of the wine; in other words, a lake. On separation by the filter and ignition in a platinum crucible, alumina remains, and may be recognised by the usual tests. In this manner $\frac{1}{3000}$ of alum (potash or ammoniacal) may be readily recognised.

Preparation of Formic Acid.—Into a half gallon retort are introduced 1 kilogram. of oxalic acid, the same quantity of syrupy glycerine, and 100 to 200 grams. of water. A receiver is adapted and a gentle heat applied, scarcely exceeding 212°. Carbonic acid gas is given off; a little water and formic acid distil over, and in about 12 hours there remains in the retort glycerine charged with formic acid. It is separated as follows:—Pour into the retort a pint of water, and distil. Replace the water until 6 or 7 quarts of distilled liquor have been received. Glycerine remains alone in the retort, and may be used for decomposing fresh portions of oxalic acid. By this method three parts of oxalic acid yields a little more than one part of formic acid. Care should be taken not to raise the temperature too high.

Sulphuret of Carbon as a solvent for Oils, &c.—M. Deiss proposes the sulphuret of carbon as a means of extracting fatty oils from certain seeds, and for scouring greasy wool. The grease of the wool is in this manner utilised, being fit for employment in the manufacture of cheap soaps. The fat from bones may also be more economically extracted in this manner than by the usual process of boiling, which wastes a considerable part of the gelatine, and thus causes an inferior animal charcoal to be produced. Bisulphuret of carbon has great advantages as a solvent, from the low temperature at which it boils, and the fact that it distils over without residue. M. Deiss is of opinion that it might be manufactured for about £16 per ton if in large demand.

Antimonial Vermilion.—Mix 4 quarts solution chloride of antimony (prepared by dissolving the black sulphuret in common muriatic acid and diluting with water down to 25° Beaume) and 6 quarts of water in a stoneware basin, and then add 10 quarts solution of hyposulphite of soda, likewise marking 25° Beaume. Place the basin in a water bath heated to boiling. At 86° Fahr. the precipitate begins to form, and at 131° Fahr. the basin is withdrawn from the bath. The clear liquid is drawn off, and the precipitate washed, first with water containing 1-15th of muriatic acid, and then with pure water.

ANSWER TO CORRESPONDENT.

'Amphion.'—The presence of turmeric in mustard may be detected by means of ammonia, which gives a reddish brown colour.

REVIEWS.

A Catechism of the Steam-Engine, in its various Applications to Mines, Mills, Steam Navigation, Railways, and Agriculture; with Practical Instructions for the Manufacture and Management of Engines of every Class. By John Bourne, C.E. Fourth Edition, greatly enlarged and improved, and illustrated by eighty-nine wood engravings. London: Longman, 1856. Foolscap 8vo. 558 pp. Price 6s.

The Catechism of the Steam-Engine was not intended as a substitute for the larger Treatise on the Steam-Engine, by the Artizan Club, edited by Mr. Bourne, but should be regarded as an introduction and, in some measure, also, as a supplement to that work. Without the aspiring and striking pretensions incident to a complete elucidation of the steam-engine and the principles governing its action, it furnishes, not only the general information which every well-informed man in the community desires to possess on the agent which distinguishes the present age from any other, but it smooths the paths of science by a judicious and well-digested abstract of her scattered elements, and, from its large store of well-arranged facts will, perhaps, supply something in the way of novelty to the most accomplished engineer. It embodies the best information upon the subject of which it treats, not deduced from mere theoretical considerations, but derived from the practice of the author and other experienced engineers of the present time. The addition of illustrations and new matter to the earlier editions has been so extensive, and the improvements in arrangement so complete, that this new edition is almost a new book. The introductory chapter is devoted to the classification of engines, involving the utility of the vacuum in condensing engines; a brief summary of the mechanical powers and the central forces, illustrated by calculations of the bursting force of fly-wheels and railway tires, and of governors; and to friction; and the strength of materials and strains subsisting in machines. We gather from this chapter, that it has been found by experiment, that cast-iron, of which the crushing weight per square inch is about 42 tons, will, if re-melted twelve times, bear a crushing weight of 70 tons, and if re-melted eighteen times, it will bear a crushing weight of 83 tons; but taking its brittleness or power to resist impact in its first state at 706, this power will be raised at the twelfth re-melting to 1,153, and will be sunk at the eighteenth re-melting to 149.

Chapter I. contains a general description of steam-engines and boilers, and is well-illustrated by drawings of the different varieties of each. As an instance of the information which Mr. Bourne condenses within a small space and delivers with clearness, we give his examples of express locomotives, omitting the wood-cuts, which furnish an excellent idea of their general construction:—

"The cylinders of Gooch's engines," adapted to the wide gauge of the Great Western Railway, "are each 18 inches diameter, and 24 inches stroke; the driving-wheels are 8 feet in diameter; the fire-grate contains 21 square feet of area; and the heating surface of the fire-box is 153 square feet.

"There are, in all, 305 tubes in the boiler, each of 2 inhes diameter, giving a heating surface in the tubes of 1,799 square feet. The total heating surface, therefore, is 1,952 square feet. Mr. Gooch states that an engine of this class will evaporate from 300 to 360 cubic feet of water in the hour, and will convey a load of 236 tons at a speed of 40 miles an hour, or a load of 181 tons at a speed of 60 miles an hour. The weight of this engine empty is 31 tons; of the tender 8½ tons; and the total weight of the engine, when loaded, is 50 tons.

"In Crampton's narrow gauge locomotive, the *Liverpool*, the cylinders are of 24 inches diameter and 18 inches stroke; the driving-wheels are 8 feet in diameter; the fire-grate contains 21½ square feet of area; and the heating surface of the fire-box is 154 square feet. There are, in all, 300 tubes in the boiler, of $2\frac{3}{16}$ inches external diameter, giving a surface in the tubes of 2,136 square feet, and the total heating surface of 2,290 square feet. The weight of this engine is stated to be 35 tons, when ready to proceed on a journey. Both engines were displayed at the Great Exhibition, in 1851, as examples of the most powerful locomotive-engines then made. The weight of such engines is very injurious to the railway; bending, crushing, and disturbing the rails, and trying very severely the whole of the railway works. No doubt the weight might be distributed upon a greater number of wheels, but if the weight resting on the driving wheels be much reduced, they will not have sufficient bite upon the rails to propel the train without slipping. This, however, is only one of the evils which the demand for high rates of speed has produced.

"The width of the railway, or, as it is termed, the *gauge* of the rails, being in most of the railways in this kingdom limited to 4 ft. 8½ in., a corresponding limitation is imposed on the diameter of the boiler, which, in its turn, restricts the number of the tubes which can be employed. As, however, the attainment of a high rate of speed requires much power, and, consequently, much heating surface in the boiler, and as the number of tubes cannot be increased without reducing their diameter, it has become necessary, in the case of powerful engines, to employ tubes of a small diameter and of a great length to obtain the necessary quantity of heating surface; and such tubes require a very strong draught in the chimney to make them effective. With a draught of the usual intensity the whole of the heat will be absorbed in the portion of the tube nearest the fire-box, leaving that portion nearest the smoke-box nothing to do but to transmit the smoke; and with long tubes of small diameter, therefore, a very strong draught is indispensable.

"To obtain such a draught in locomotives it is necessary to contract the mouth of the blast-pipe, whereby the waste steam will be projected into the chimney with greater force; but this contraction involves an increase of the pressure on the eduction side of the piston, and, consequently, causes a diminution in the power of the engine. Locomotives with small and long tubes, therefore, will require more coke to do the same work than locomotives in which larger and shorter tubes may be employed."

The second chapter is devoted to heat, combustion, and steam. A pound of the best Welsh or anthracite coal is capable of raising from 9½ to 10 lb. of water from 212° into steam, whereas a pound of the best Newcastle or bituminous coal is not capable of raising more than about 8½ lb. of water from 212° into steam. In some of the Cornish boilers, however, a pound of coal converts 11·8 lb. of boiling water into steam; but from 6 to 8 lb. is the usual proportion in boilers of medium quality, the difference depending on the kind of boiler, the kind of coal, and other circumstances. The readiest way of burning the smoke is to have a large proportion of furnace, and careful firing. The method of admitting air into the flues with an intermittent generation of smoke requires constant attention, and generally involves an increased consumption of fuel, though a carefully performed experiment usually demonstrates a saving of 10 or 12 per cent. Machine firing is preferable, and may be applied even to steam vessels. M. Regnault has shown that the total heat in a given weight of steam increases slightly with the pressure. Thus, in steam of the atmospheric pressure, or 14·7 lbs. per square inch, the sensible heat is 212°, the latent heat 966·6°, and the sum 1,178·6°; whereas in steam of 90 lb. the sensible heat is 320·2°, the latent heat 891·4°, and the sum 1,211·6°. It is not deemed advisable to disturb the rules of Watt and Southern, with which the practice of engineers is identified, for the sake of emendations which are too slight to influence materially the practical result.

The expansion of steam and action of the valves are fully explained in the third chapter. It appears to be indispensable to the realisation of any large amount of benefit by expansion that the cylinder should be enclosed in a steam jacket, or otherwise effectually protected from refrigeration. Separate expansion-valves are unnecessary. Diagrams taken from engines working expansively with the link-motion and throttle-valve show an excellent result.

The next chapter is devoted to the power and performances of engines and boilers. The most feasible way of working condensing-engines at high speeds appears to lie in the application of weights to balance the momentum of its moving parts, making the frame strong and rigid, and performing the condensation partly in the air-pump to insure a better vacuum and superior action of the air-pump valves.

The next four chapters are on the proportions of boilers and engines, and their constructive details. In flue boilers the evaporation of one cubic foot of water per hour produces 1 H.P., exclusive of expansion, and requires about 8 lb. of coal and 9 square feet of flue surface. Boulton and Watt allow in their modern flue boilers for the evaporation of a cubic foot of water 8 square feet of heating surface, 70 square inches of fire-grate, 13 square inches sectional area of flues, 6 square inches area of chimney, 14 square inches area over furnace bridges; ratio of area of flue to area of grate, 1 to 5·4. In tubular boilers, the proportions are—heating surface, 9 square feet; fire-grate, 70 square inches; sectional area of tubes, 10 square inches; sectional area of back uptake, 12 square inches; of front uptake, 10 square inches; and of chimney, 7 square inches; ratio of diameter of tube to length of tube, 1 to 28 or 30; cubical content of boiler, exclusive of steam-chest, 6·5 cubic feet; content of steam-chest, 1·5 cubic feet. These proportions do not apply to locomotives where the projection of the exhaust steam up the chimney occasions a more rapid combustion. A large and high chimney is not conducive to strength of draught in locomotives. A chimney three or four times its diameter in height answers as well as a longer one; in an engine with 17-inch cylinders a chimney of 15¼ inches was substituted for one 17½ inches diameter, and produced a superior result.

"Boulton and Watt's rule for the dimensions of the chimney of a land engine is as follows:—Multiply the number of pounds of coal consumed

SEBILE'S IMPROVED SMOKE-CONSUMING FURNACE.

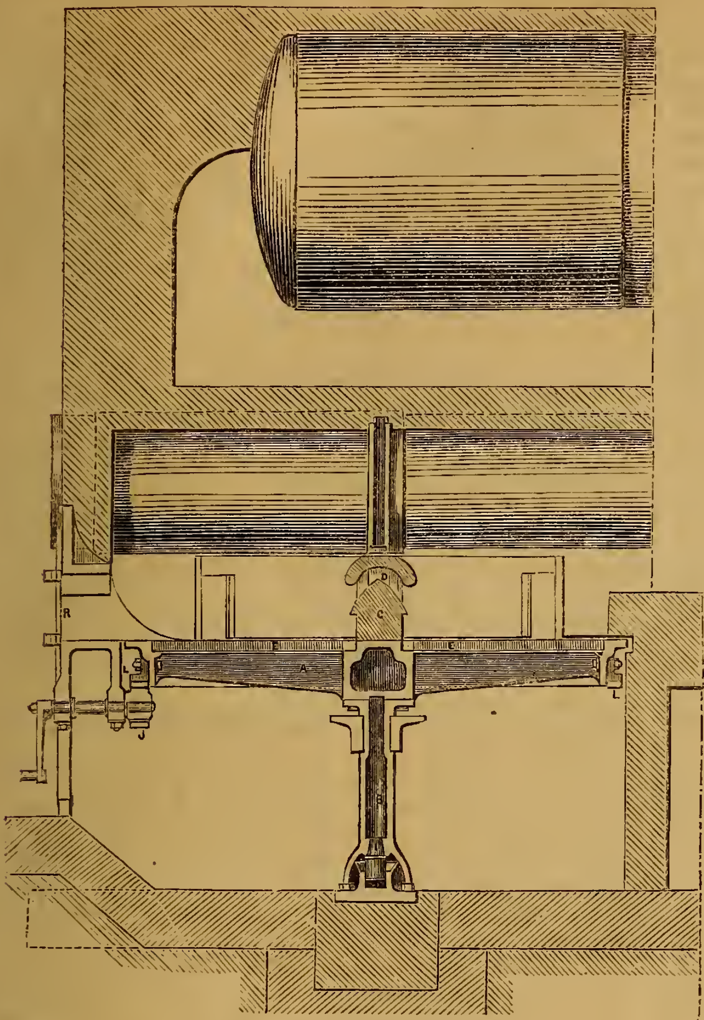


Fig. 1.—Sectional Elevation.

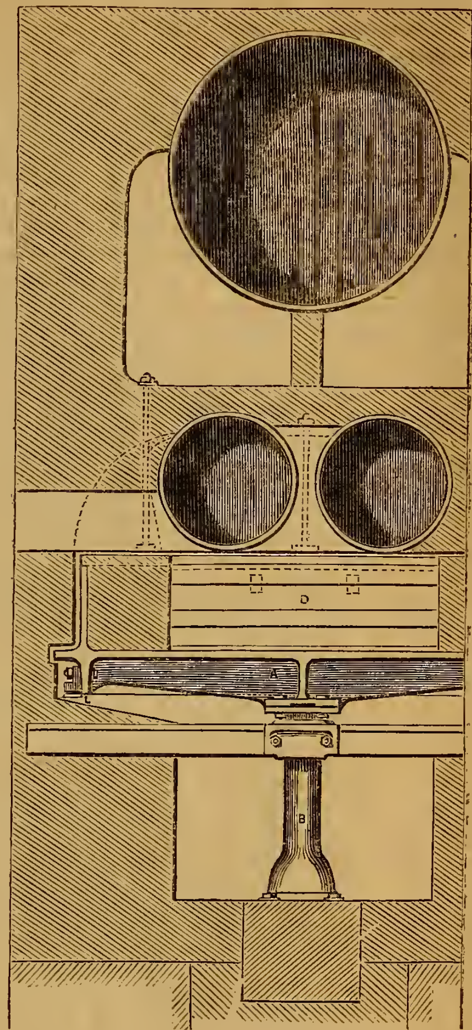


Fig. 2.—Transverse Section.

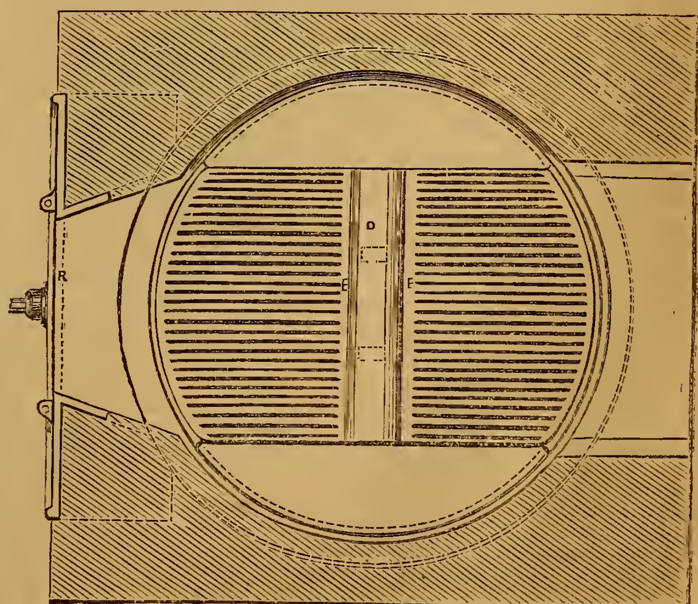


Fig. 3.—Plan.

by a half revolution presents alternately one of two sets of the furnace-bars for a charge of fresh fuel, and the more remote hearth or set of furnace-bars will contain the fuel in a high state of ignition or incandescence, whilst the gases given off from the fresh fuel must pass there through, and become ignited and consumed thereby.

A perforated bridge may divide the two furnaces extending from side to side, and permitting the gases and particles of carbon from the outer furnace or that nearest to the front of the boiler to pass only in the desired direction.

This furnace effects considerable economy in the consumption of fuel, because a large amount of the gases or heat giving qualities, which, in furnaces of ordinary construction, escape in the form of smoke and fine particles of carbon, whilst they cannot so escape in this furnace, but impart fresh aliment to the second furnace ; moreover, the cold air which is admitted into an ordinary furnace, producing a cooling and injurious effect upon the furnace and the fuel during the time the door remains open, is entirely prevented in the present furnace from so acting. When the fuel in the second furnace or the one furthest from the front of the boiler is sufficiently consumed, the frame is turned sufficiently far to bring that furnace or hearth immediately in front of the opening ready to receive a fresh charge of fuel, thus these hearths alternately change places.

THE GRAVING ESTABLISHMENTS OF PORT JACKSON.

From the "Sydney Morning Herald," December 26th, 1855.

For many years past the utter want of means to repair and refit sailing and steam ships of heavy tonnage in the harbour of Port Jackson has been universally complained of as a very serious impediment to the progress of the chief port of the South Pacific; and, of late, the construction of two dry or graving docks and a patent slip, each of a capacity to receive and thoroughly repair the largest ships afloat, has been earnestly acknowledged by the maritime and mercantile interests, not only of Sydney, but of every other port in this and the neighbouring seas, as the most important and valuable achievements which either public or private enterprise has yet affected in Australasia. We need not say that we are adverting to the Waterview Dry Dock; the Australasian Steam Navigation Company's Patent Slip (both finished and open); and the Fitz Roy Dry Dock (rapidly approaching to completion). Through these columns, the attention of owners and masters of vessels sailing from all parts of the world to the South Seas has been for some time past directed to the unrivalled facilities for the repair and refitting of ships which the port of Sydney now possesses; and the constant press of business which has attended the Waterview Dry Dock and the Australasian Steam Navigation Company's Patent Slip since their opening is the best proof of their importance and value to the shipping interests. We have also, from time to time, adverted to the extensive and comprehensive design presented by the Government in the construction of the Fitz Roy Dry Dock, and the certainty of Sydney becoming at once the only great docking port in the southern hemisphere.

A letter has been received in Sydney from one of the leading officers of the Peninsular and Oriental Steam Navigation Company, to the effect that, in arranging with the Home Government for the resumption of ocean steam communication between the United Kingdom and the Australian colonies, the knowledge that the Waterview Dry Dock is ready to receive steam-ships of the largest tonnage belonging to the company's fleet, had the greatest influence in satisfactorily adjusting their negotiations with the Government. Looking at the immense loss they had sustained by the long detention of the ill-fated *Crœsus* in this harbour, the company would not have entertained any proposal for the renewal of their mail contract with the Government, had they not received advices of the completion and opening of the Waterview Dock.

The Waterview Dock has already been described in the "Sydney Morning Herald."

The Fitz Roy Dry Dock is situated on the south-east of Cockatoo Island, to the westward of the harbour of Sydney, at the commencement of the Parramatta river. The area of the island is about 28 acres, with an average depth of 25 ft. of water close in to the land; its shores forming an uninterrupted site for a line of wharfage a mile in length, approachable by the largest class of vessels afloat.

The progress of the works may be thus stated:—The basin of the dock has been excavated out of compact sandstone and hard shale. The original surface of the island at the point selected for this work had 40 ft. of sandstone above high-water mark, which had first to be cleared away, thus involving an immense amount of labour. Some idea may be formed of the magnitude of this work when we mention that 3,000,000 cubic ft. of stone have been removed, of a weight equal to 200,000 tons. Of this, 200,000 cubic ft. have been quarried, and about 100,000 set. A considerable portion has been cut and employed to line the lower portion of the dock, which is excavated out of hard shale. This would not have been required had the sandstone continued to the full depth proposed, as, we may observe, was the case at the Waterview Dry Dock. Hard as was the shale upon its first exposure, and seemingly equal to the purposes of paving and lining the lower portions of the dock, experience has shown that it soon crumbles under atmospheric influences, and hence the necessity of resorting to the valuable accessory we have just named.

The floor of the dock is formed of massive blocks of stone, each 3 to 6 tons in weight. They are so cut as to form an inverted arch of 72 ft. radius. The altar stones, or steps, along the sides of the dock, are of the same massive description; each stone forming two steps of a foot-tread.

The piers, between which the caisson rests, have two sills 20 ft. apart, to which are bolted, with $1\frac{1}{2}$ in. copper bolts, the timbers, 12 by 12, to form a surface against which the caisson presses when the water is pumped out of the dock; the pressure caused by the water outside being calculated to be equal to about 400 tons distributed over the surface.

DIMENSIONS.

	South Inlet Government Dock, Portsmouth. Ft. in.	Fitz Roy Government Dock, Sydney. Ft. in.
Extreme length	335 0	336 0
Length of the floor	303 0	300 0
Extreme breadth	80 9	79 0
Extreme depth	29 0	27 0
Depth of water at spring tides	23 0	21 9
Width at entrance	70 0	60 0

The dimensions of the two docks, it will thus be seen, are of no very great difference. The South Inlet was completed in ten years, at a cost of £120,000. The Fitz Roy will have taken about eight years, when finished, at a cost to the colony of, say, £55,000; although the real value of the work which has been done, up to the present time, has been (after careful allowance for the difference between forced and free labour), estimated at £100,000.

(*To be continued.*)

ROYAL SCOTTISH SOCIETY OF ARTS.—March 10, 1856.

Professor George Wilson, M.D., President, in the Chair.

The following communications were made:—

1. *Railway Signals and their suggested Improvements.* By Mr. Thomas Sturrock, brassfounder, Thomson's-place, Leith. A model and three drawings were exhibited.—Mr. Sturrock stated that, by a very simple contrivance, he has united all the movements of the day-signal with the night-signal; done away with the third colour, or green light, by a combination of red and white only; and, by easy application of the lenses, superseded the three-lensed lamp now in use, and rendered the signal at once simple and intelligible. He stated that his improvement consists principally in the arrangement of the blades, or arms, having the lenses attached, and fixed lanterns behind the arm;—that it was equally applicable to the locomotive-engine and the tail-van of a train, thus rendering communication more efficient than at present. He also suggested improvements on the present mode of flag and hand-lamp signalling.

A discussion ensued, in which Mr. Bouch, C.E., Col. Moody, the President, Mr. Elliot, V.P., Mr. Sang, and the Secretary, took part. Mr. Bouch considered Mr. Sturrock's suggestion good for the night-signals, but that it was no improvement on day-signals, which should always be distinguished by *form* as well as *colour*. Mr. Bouch also strongly advocated the point that railway-signals should always give *positive*, and not merely negative, information. They should leave nothing to be inferred by the engine-driver.

2. *On a Correct and Cheap Assay Balance.* By Robert Aytoun, Esq., W.S. The balance was exhibited.—In this balance, as the author stated, one end of the beam is loaded with a permanent weight, while from the other end is suspended a pair of pans, one below the other. Before using the balance, it is necessary to ascertain the counterpoise or weight required to counterbalance the permanent wait on the loaded arm. For this purpose weights are to be put into one of the pans until the equilibrium is established. The greatest care must be bestowed upon this process, as the correctness of all subsequent weighings depends upon it. The weights composing the counterpoise are put into a box, and the instrument is now ready for use. The substance to be weighed is to be placed in one of the pans, and weights taken from the box are to be put into the other till the equilibrium is established. The weights *which remain in the box* give the weight of the substance. The weight thus determined is totally free from the numerous errors which occur in the ordinary process of weighing, where the substance and corresponding weights are suspended from the opposite arms of a balance. A second improvement was stated to be gained in this balance by the use of needle-points instead of knife-edges. By this substitution great delicacy is obtained, and means of immediate repair are placed within the reach of the operator.

April 14, 1856.

James Elliot, Esq., Vice-President, in the Chair.

1. *On the Angular Movements of Ships, the Measurement of the Amount, and the Elimination of their Effects in certain Cases.* By Professor C. Piazzi Smyth, F.R.S.E., Astronomer Royal for Scotland. Illustrated by Working Models.—These angular movements were resolved into three varieties—viz., rolling, pitching, and yawing; or two deviations *from* the horizontal plane, and one deviation *in* the same; and were described as being those which most rendered astronomical observation difficult at sea, and in some cases impossible. To obtain numerical particulars of the amount and nature of such movements, the author had invented, and now exhibited, two new species of ship-clinometers, one of them based on the principle of a level with an *infinitely small* bubble, and the other on the persistence of a free axis of rotation. The freedom of both these instruments from the errors of most ship-clinometers was demonstrated before the Society. To eliminate the effects of such angular movements of ships was a second part of the paper; and by employing a *balanced* frame and one or more axes of free rotation, the author had contrived to keep small tables perfectly uninfluenced by any angular motion of ships,—even by their most violent lurches. He had, as yet, only tried apparatus large enough to carry the astronomical instrument; but he exhibited models of others, calculated, by their principles of arrangement, as well as by their size, to carry the observer also; and,

amongst other methods of producing the necessary speed of rotation, he had devised a new form of driver, by which water or steam might produce in the first mover the highest velocity required, without the interventiou of wheelwork. He then described the practical poiuts necessary to be attended to, in order to bring out in the utmost force the peculiar qualities of a *free* axis of rotatiou; and concluded by illustrating with the apparatus on the table the true and the erroneous principles of philosophising, and gave some curious applications to moral, as well as natural, philosophy.

Mr. Elliot (V.P.) congratulated the members on the value of the communication which had just been laid before them by Professor Smyth. He said that he had often listened with pleasure to the detail of ingenious inventions, such as those in which our age abounds; but he had never enjoyed a greater treat in that way than ou the present occasion. The apparatus before them displayed unusually happy applications of the principles of mechanical science, a singular felicity of ingenious resources, and exquisite workmanship. We here beheld a good specimen of the intimate connexion which subsists between theory and practice. The doctrines of rotatory motion, which were at first regarded as mere subjects of theoretical investigation and wrapped up in mathematical formulæ, and subsequently brought out to illustrate natural phenomena, were now being turned into purposes of refined practical utility. He was glad to see so numerous an assembly on an evening in which the attraction on the opposite side of the street was so powerful; but if the audience were of his mind they were well repaid. At the previous meeting of the Society, a complaint was made that science did not receive in this country that amount of patronage from Government which was conferred upon it on the Continent; but he thought that science was making such advances that it might aspire to patronise royalty itself. If Her Majesty had occasion to take a voyage in rough weather, she could not have a greater favour conferred upon her than a seat mounted as Professor Smyth had described, unmoved by the agitation of the waves, and in perfect repose amidst the fury of the tempest.

Mr. Sang said that, in his opinion, Professor Smyth had hardly done justice to himself, or to the importance of the objects sought to be accomplished. Astronomical observations at sea are exceedingly difficult, and yet are essential to the navigation of a ship. Thus, after a long storm the altitudes of two stars, well taken, may enable the mariner to compute his latitude and longitude without dependence upon his dead reckoning. In long voyages the rates even of the best chronometers have to be checked, and this can only be done by reference to lunar distances, or to the eclipses of Jupiter's moons. Now, a telescope mounted on one of Professor Smyth's frames, without the observer needing to accompany it, would remain sufficiently well-directed to the planet to permit the observation of an eclipse. And, again, a far less degree of steadiness than that which the Professor aims at would enable the seaman to take his lunar distance with almost as much precision as we can do on shore. There can be no doubt, then, that the introduction of such apparatus would be attended with most useful results: it would mark a new era in the practice of Nautical Astronomy.

CORRESPONDENCE.

REMARKS UPON THE CONSTRUCTION OF CANNON.

To the Editor of The Artizan.

Sir,—The questiou has been raised as to constructing cannon of sufficient strength to resist the proof-charge, and for active service. A variety of experiments have been made with varied success; but none hitherto with satisfactory results—cast-steel, wrought-iron, cast-iron, and segmental steel guns hooped with wrought-iron collars, bored steel tubes enveloped in cast-iron, and guns of mixed metal, three of which, 24-pounders, burst the first round in succession with the ordinary proof charge.

It is admitted that Swedish and Russian iron is of greater tenacity than British; and also that the vent or touch-hole of Russian cannon remains comparatively uninjured to a three or four-fold degree to that of British iron guns.

These considerations have induced the following remarks, conceived as remedies for the defects complained of, as above stated: and also an improvement in the vent or touch-hole of cannon, to prevent the escape of any portion of the charge of gunpowder with which they are loaded.

To effect the first object, after cast-iron cannon have been made in the usual manner of the usual thickness of metal, giving preference to Lowmoor or Bowling (Yorkshire) iron, then to hoop-bind and hammer around the external surface—from about the muzzle to the breech—red-hot wrought-iron collars of a suitable breadth, thickness and distauce, the one from the other, so as to leave spaces of a few inches between them, whereby a lock and key would be formed to receive the molten metal or cast-iron jacket of such thickness as may be deemed requisite, the gun being placed, with the muzzle closed, in a vertical position, and a large head of metal left at the top end, and when all parts of the gun are cooled, then to detach the said head of metal.

To effect the second object—an improved vent or touch-hole of any description of ordnance or cannou—in lieu of the vent being perpendicular at the breech, over the lower end of the cartridge of gunpowder an oblique aperture is left or made at a short distance from the breech, or at such distance and angle inclining downwards therefrom, so that the aperture opens at the end of the cartridge next to and in contact with the shot or shell. In the aperture a female screw is to be cut to receive a male screw, cut on the lower end of a gun metal or platina tube, to the lower end whereof, extending to the bore of the barrel of the gun, a platina drop-valve is hung at an angle to permit it to close the orifice of the tube slightly; at this end the said valve is surfaced or ground air-tight into a seat, so as to shut closely when the cartridge is passed into the chamber of the guu, which when fired, the valve becomes hermetically closed, and no portion of the explosive force of the charge of gunpowder escapes at the vent. When the gun is loaded and to be discharged, a metallic pricker is passed down the said tube to the extent to pierce the cartridge, and then the port-fire is introduced, the top end of which is covered aud protected from the weather by a hinge cap-lid hung to the upper end of the platina tube.

The advantages of these contrivances would be that if perchance the platina valve should become deranged, another tube and valve could easily be substituted; or in the event of abandoning cannou, then in lieu of spiking them the platina tube and its valve could quickly be removed, and thereby the gun rendered useless to the captors, as the aperture in which the tube had been screwed would be too large for a vent. Again, cannon with the ordinary vent, or those spiked and completely closed, the oblique aperture, with female screw for receiving the platina tube and its appendages, can be made at such further distance from the original vent as to render the gun serviceable—or as a variation, the said tube and valve may be introduced horizontally at the centre of the caskabel; but an oblique introduction, as described, is preferable, as there are reasons for believing that a more complete explosion of the cartridge of gunpowder is effected when fired at that end in contact with the shot or shell, and not otherwise.

H. T. Crosley.

To the Editor of The Artizan.

Sir,—In answer to your correspondent, "Factus," concerning the locality of brine in a boiler under steam, and, consequently, the best position for the mouth of the blow-off pipe in the boiler, my opinion is that in a common flue boiler, with the water spaces connected at bottom, it would be under the ash-pit.

In a tubular boiler where the water spaces are not connected below, I have found the iuternal mouth of the brine-pipe to be most serviceable in keeping the boiler clean, when placed between the top of the tubes and the surface of the water.

In some instances the service blow-off pipe is connected with a refrigerator or chamber, fitted up with a number of small tubes. The brine passes through this, filling the spaces between the tubes, while the feed-water passes through the tubes on its way to the boiler, thus extracting the heat. In this case the blow-off is constant.

With regard to blowing off at the bottom, I may state that I have observed in a boiler where the blow-off is fitted to the bottom of a water space that communicates with no other, but over the furnaces,—that although the blow-off cock is regularly attended to, this water space fouls as much as the others, barring the loose scale that falls into it from the tubes above, which is, of course, blown out, while in the others this accumulates.

In this boiler, the top of the back flue, which unites the furnaces with the tubes, is the highest part of the boiler covered with water, and has quite as much scale on it as anywhere.

From this I am of opinion that in some constructions of boilers, when under steam, the heaviest brine is near the surface.

I am, &c.,

Folkestone, April 17th, 1856. Ernest.

SCREW *v.* PADDLE.

To the Editor of The Artizan.

Sir,—In common, I have no doubt, with many others, I have been much interested in the perusal of the comparative results obtained from the screw and paddle-wheel, in the steam ships *Himalaya* and *Atrato*, as reported in The Artizan for December, 1855.

The superiority of the *Himalaya* over the *Atrato* is certainly striking, and hitherto unexampled; and if we could be quite sure that the *Atrato* was, as to her sailing qualities, in every respect equal to the *Himalaya*, and that the engines of both ships were working under equally favourable conditions, nothing would be left to us but to admit the fact, with the smallest possible chance of our ever being able to explain it.

To me—I say it with all deference to your greater experience—there does not appear to be such a close analogy between the two cases. In the first place, the *Atrato* is about 20 ft. shorter than the *Himalaya*; in the next place, she has not the same lines as the *Himalaya*; and, thirdly, she had not been docked for some time, which was not the case with the *Himalaya*.

I apprehend that it would be difficult to deduce from theory such rules as would enable us to compute, with any degree of accuracy, the influence of the shorter length and blunter shape upon the speed of the *Atrato*. But we know, for instance, that the performance of the *Dauntless*, after she had been lengthened 8 ft., was increased 82 per cent.; and that, after the stern of the *Rifleman* had been sharpened, her performance rose 53 per cent.

Any attempt to compute, theoretically, the effect of the *fouling* would be still more fruitless; but I read in one of the daily papers, a short time ago, that the speed of the *Himalaya*, on her last voyage home, was reduced 3½ knots per hour, in consequence of *fouling*, as compared with her performance immediately after she had been docked.

It is but reasonable to infer, from the description given of the engines and paddle-wheels of the *Atrato*, that a considerable portion of the power must have been absorbed by friction. This point, however, could be experimentally ascertained by means of the indicator.

When you say that of the true nature of the action of the screw so little is thoroughly understood, I quite agree with you. In a general way, however, we are so far from acknowledging our ignorance upon this subject, that instead of endeavouring to *learn* from experience what the action of the screw-propeller *is*, we *prescribe* what it *ought to be*. And when we fail in reconciling the experimental results with those computed according to the laws of our own making, instead of suspecting that there might possibly be an error on our part, we very ingeniously set those results down as apparent anomalies, and try to account for them upon hypotheses which are, at the least, as extraordinary as the anomalies themselves.

For instance, we are perfectly satisfied that the velocity of the screw-propeller is to be computed exactly in the same way as the speed of an ordinary screw. No; I beg pardon. We call the number of revolutions, multiplied by the pitch, the speed which the screw-propeller *would* have if working in a solid nut; but in other respects we deal with it and make our comparisons with it precisely as though that were the real velocity of the screw-propeller,—that is, of the propelling area of the screw.

Now, what have we to do with the velocity which the screw *would* have if working in a solid nut? *Has* the screw-propeller such a velocity? If so, in what direction does it move? We say that the screw *must* necessarily move slower, and that it absolutely *cannot* move faster, than the ship. How can it do either the one or the other so long as the axis of the screw is connected with the ship? And if the screw *did* move in the same direction as the ship, as it *would* do if it worked in a solid nut, how could it propel the ship at all consistently with the principles of propulsion, which require that the propelling area and the object propelled should move in opposite directions? If we require the velocity of the screw for anything, it must be to ascertain its effect; but what useful or rational result can we possibly expect to arrive at by introducing an imaginary velocity? In any other case we should ridicule the very idea of such a proceeding.

Then there is the *slip* of the screw, the co-efficient of which we profess to ascertain by deducting from the velocity which the screw *would* have, if working in a solid nut, the speed which the ship *actually has* at the time of trial, and dividing by the (so called) velocity of the screw. Now, either the term "slip" is an arbitrary one, having no particular meaning, or it is subject to a general definition, applying to all kinds of propellers. In the former case all argument would be worse than useless. If, however, by "slip" we mean the difference between the velocity of the propelling area and the speed of the ship, what business have we to compute it by taking *that* as the velocity of the screw which it *would* have if working in a solid nut, and which, *for that very reason*, it does *not* have as a propeller?

The only orthodox theory extant upon the important subject of screw propulsion is that of M. Labrousse.* M. Labrousse demonstrates that *that* part alone of the force which acts in the direction of the screw-shaft is effective in propelling the ship; the force acting in a plane perpendicular to the screw-shaft being lost, so far as the propulsion of the ship is concerned. This being the case it follows, I think, that the power which is requisite to propel the ship $\left(v \, K \, u'^3 \left(\frac{i\,l}{u'} - v \right)^2 \int \frac{r^3\,d\,r}{u'^2\,r^2 + l^2} \right)$ [see M. Labrousse's Treatise, page 68] is—except in appearance, when written under the above form—quite independent of the power which keeps the screw in motion $\left(i \frac{l}{u'} K \, u'^3 \left(\frac{i\,l}{u'} - v \right)^2 \int \frac{r^3\,d\,r}{u'^2\,r^2 + l^2} \right)$ or the *engine power*; because the force applied by the engines acts in a plane perpendicular to the screw-shaft, and the resistance which the screw has to overcome, in the direction of its motion of rotation, is the measure of that force.

It also follows, from M. Labrousse's investigation, that a portion $\frac{u'\,v}{i\,l}$ only of the total power exerted by the engines is available for the propulsion of the ship, the remainder being lost in consequence of the displacement of the water or the "slip." Now the total power exerted by the engines is represented by $K \frac{l}{u'} \left(\frac{i\,l}{u'} - v \right)^2 \int \frac{r^2\,d\,r}{u'^2\,r^2 + l^2} \times i\,r$; and the term before the sign of multiplication is that force which is *lost*, so far as the propulsion of the ship is concerned.

It is much more easy to assert that loss of power is the result of slip than to establish the doctrine as a matter of fact upon the strength of the experiments which are on record; although, if that article of our screw-propelling creed were unimpeachable, it would be an easy task for engineers to overcome the difficulty by simply reducing the pitch of their screw-propellers.

As for the theoretical proof, I conceive that we are not bound to believe more than M. Labrousse tells us* (page 68); which is, that *if* the projection of the screw-blades upon a plane perpendicular to the screw-shaft, multiplied by a function of the angle of the screw, were the propelling area; and *if* that propelling area moved in the water in a *contrary* direction to that of the ship, at the velocity which the screw *would* have if moving in a solid nut, then there would be loss of power by slip to the extent above indicated.

We are taught, in all works on elementary mechanics, that when the wind impinges against the vanes of a windmill, a portion of the pressure acts in the direction of the axis, whilst another portion takes effect in a plane perpendicular to the axis of the vanes. The screw-propeller, when the ship is in motion, presents an analogous case; the only difference being that the screw-blades impinge against the water, whilst in the windmill the wind impinges against the vanes. But, because we have agreed beforehand how the screw-propeller *would* act if it obeyed the laws of fluid resistance as well as we understand them, we cannot allow that the motion of the screw-blades against the water produces a similar effect in the direction of the axis of the screw, as the motion of the wind produces in the direction of the axis of the windmill. We, therefore, attribute to the slip an expenditure of power which we should otherwise be able to attribute to something more substantial.

In cases where one ship is set to tow others, or where headwinds have to be encountered, the per-centage of (what we have agreed to call) slip becomes very considerable, and appears, sometimes, to be nearly proportionate to the per-centage of power expended, which the dynamometer leaves unaccounted for. But instead of taking it for granted that such per-centage of power is lost because of the slip, we ought, I think, to consider that when an external force acts upon the ship in the contrary direction to that in which it has to move, no forward motion can take place unless that opposing force be previously *balanced*. The engines have, therefore, to exert a power corresponding to the number of revolutions of the screw which is necessary to produce a strain equal to the opposing force, in *addition* to the power which is necessary to move the ship and to overcome the extra resistance produced by the opposing force. The dynamometer, however, takes cognizance of the direct resistance only.

When the *Rattler* and the *Alecto* were tied stern to stern, the strain exerted by the screw of the *Rattler* had to *balance* the strain produced by the action of the wheels of the *Alecto* before the former could tow the latter. Therefore, the engines of the *Rattler* must have developed such a power as corresponded to the number of revolutions of the screw, which would cause it to produce a strain equal to that exerted by the wheels of the *Alecto*, *besides* the power required to overcome the direct resistance, as indicated by the dynamometer.

If it be a well-ascertained fact that an increased resistance *increases* the slip of the screw, it is equally true that when an external force acts upon the ship in the direction of its motion, the slip of the screw is *reduced*. It may, therefore, be asked: if power is *lost* by an increase of slip, must there not be *power gained* by a diminution of it?

Volume X. of The Artizan, page 205, contains an account of the performances of the screw steam-frigate *Arrogant*. When tried at the measured mile in the Thames, January 8, 1849, this frigate—it is reported—went at the rate of 7·25 knots per hour, the engines exerting 672·7 H.P. Somewhat more than two years later the *Arrogant* made, between Gibraltar and Lisbon, in smooth water, with a strong free wind and all sail set, 10·6 knots per hour, the engines developing 767·45 H.P., and the

* Extrait de la Revue Générale de l'Architecture et des Travaux Publics.—Des Propulseurs Sous-Marins, Paris, aux Bureaux de la Revue Générale de l'Architecture et des Travaux Publics, 6 Rue de Furstemberg, 1843.

* "L'effet de la vis est donc le même que celui d'une surface normale Ag, qui se ment dans l'eau en sens contraire du bâtiment, avec une vitesse égale à la tang. e."

screw having a "negative" slip of 12 per cent. In the absence of more correct information we will suppose the actual propelling power, in the first case, to have been one-half of the gross power, or 337 H.P. Now, to propel the *Arrogant* at the rate of 10·6 knots per hour by means of the screw only $\left(\frac{10\cdot6}{7\cdot25}\right)^3 \times 3\cdot37 = 1{,}053$ H.P. would have been required, consequently, when she was propelled by sail and steam combined, 622 H.P. must have been *gained* somehow.

If it be true that there was a (so-called) "negative" slip, that "negative" slip must have created 622 H.P. which the engines were incapable of developing. If, on the other hand, the slip was, in spite of appearances, "positive," a loss of power must, according to our accepted doctrine, have been the consequence, although the fact is that 622 H.P. were actually gained.

Neither of these conclusions being quite satisfactory, I am inclined to the opinion that as an opposing force has a tendency to drive the ship a-stern and to *increase* the resistance of the ship, so an auxiliary force has a tendency to move the ship a-head and to *diminish* the resistance of the ship. In the former case, as I have already observed, not only has the opposing force to be balanced by an additional effort of the engines before the ship can move a-head, but the engines have, besides, to do more work in order to overcome the additional resistance of the ship. Whilst in the latter case the engines are not only relieved to the extent of the power developed by the auxiliary force, but have also to do less work by reason of the diminished resistance of the ship.

I beg to apologise, Mr. Editor, for sending you so lengthy a communication. I have been considering for some time whether to trouble you with it or not; and if I have decided upon the former course, it is not with the object of re-opening a controversy upon a subject which has already been so vehemently discussed on various occasions, but merely to make a few observations and suggestions upon the mystery in which screw-propulsion seems to be involved.

I am, Sir, your obedient servant,

April, 1856. V.

To the Editor of The Artizan.

Sir,—In reply to the queries of your Wakefield correspondent respecting peat and peat machinery, I may state that after much study of the subject and great attention to the means which different parties have adopted during the last thirty years, I have come to the conclusion that to the Messrs. Gwynne belongs the credit of overcoming the difficulties which previously stood in the way of the use of peat as a general fuel, as well as one particularly adapted for *metallurgical* purposes. The machinery of the Messrs. Gwynne for compressingpea I have, along with many others, seen at work, and most effectively perform its duty. In noticing *the result*, I will, perhaps, best answer the end required by quoting a single passage from an able pamphlet upon "Peat and its Products," by Mr. E. H. Durden, F.C.S., of the Airedale Chemical Works, Hunslet, Leeds, wherein he states:—"The solidified peat manufactured by means of machinery, patented by Messrs. Gwynne and Son, is the best specimen of compressed peat fuel which has yet been brought out. It contains three volumes of dried peat compressed into one, and has about the same specific gravity as coal. Its percentage of moisture has been reduced by desiccation from 25 to 6·5."

The great desiderata hitherto to the adoption of peat have been the amount of moisture, and the extreme bulk of the crude material. Those evils having been corrected, it is only necessary to remark that there is nothing new in the fuel itself which has been used in this and other countries for ages in an imperfect state; and the only remaining difficulty at the present time is that of convincing persons that it is really *valuable* in its improved form. That peat has been and still is used for smelting iron ore, is well known to every one who has read or paid attention to the history of the trade. Some of our Continental neighbours use peat at present and have done so for centuries for smelting, even with badly prepared material. In Ireland and Scotland very superior iron was wont to be produced from peat fuel, which, however, has fallen into disuse from the facility of procuring coal and its *supposed* cheapness: whereas the fact is altogether blinked that iron made from fuel containing sulphur, of which the metal is most tenacious, cannot be produced of fine quality, and, consequently, this country has been and still is dependent upon foreign supplies of charcoal iron, which could be made *at home*, with an outlay moderate indeed in comparison with the advantages to be derived, as metal equal to that of Sweden and Russia could be obtained by the use of peat, *and at the same cost as the present coal-made iron.* In this there is no exaggeration, and foreigners in every part of Europe, who finding wood becoming scarce, are daily seeking for information in this country as to the best mode of improving the preparation of peat for their smelting and puddling works. Thus, while foreign countries are progressing in the manufacture of iron by taking advantage of nature's gifts, England, which generally is to be found in the foremost ranks of the improvement phalanx, has apparently halted before entering upon this valuable resource of the country. I fear to trespass further upon your valuable space, otherwise I could adduce many circumstances in corroboration of what I have stated, which, at a future time, with your permission, I may recur to. Meantime,

I remain, Sir, your obedient servant, James C. Kemp.

NOTES AND NOVELTIES.

Saw-set for Circular Saws.—In the invention illustrated by the accompanying engravings the saw is secured upon the inclined hinged leaf, A, by means of the screw, B, which passes through the centre of the saw. The leaf, A, it will be observed, is slotted, so that the screw, B, can be moved to accommodate different sized saws. The screw, B, is furnished with expanding arms, C, which are hinged to the body of the screw, so that the arms are expanded or contracted, according to the direction in which the screw is turned. The office of the arms is to touch upon the inner edges of the arbor hole of the saw, and thus form a pivot upon which the saw is revolved; the arms are made to expand in order to suit different sized arbor holes. E is a nut that screws down upon the arms, C, and holds them in any given position. In Fig. 2 the nut, E, is removed so as to show the arms, C, very plainly. B′ is another nut on the end of the screw, B, that binds the latter and its appurtenances to the leaf, A. The saw being revolved by hand, its teeth are brought, one by one, beneath the hammer, D, and set by a blow upon the hammer in the usual manner. D′ is a spring that lifts the hammer again, when it is struck down. The guides, E, are rendered adjustable by means of set screws, E′. The inclination of the leaf, A, is adjusted by means of the screw-piece, F, which is operated by the thumb-screw, G. The various parts of the apparatus are attached to a square block of wood, H, furnished with a plug, I, to fit into a bench or stand.

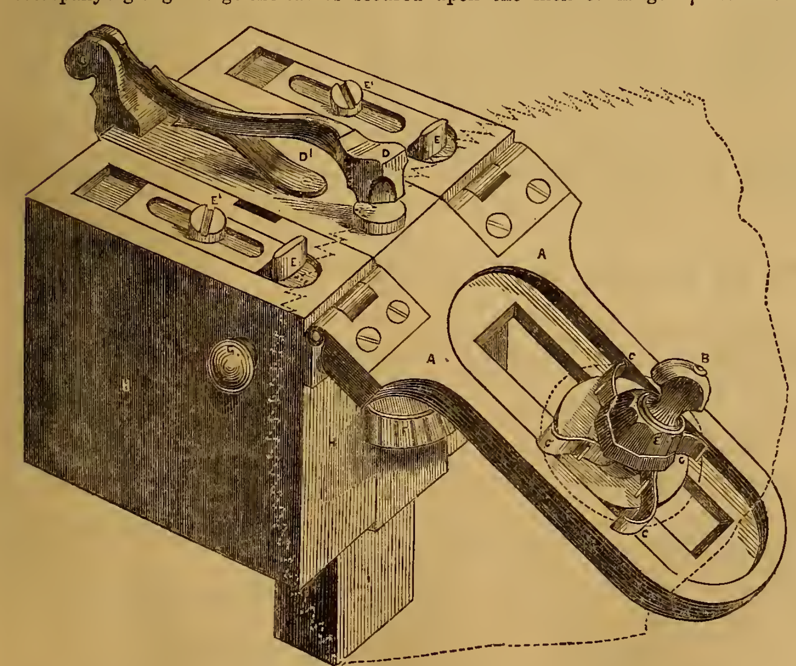


Fig. 1.

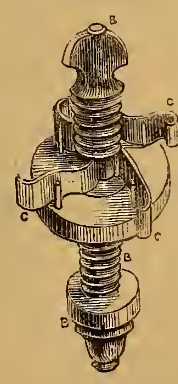
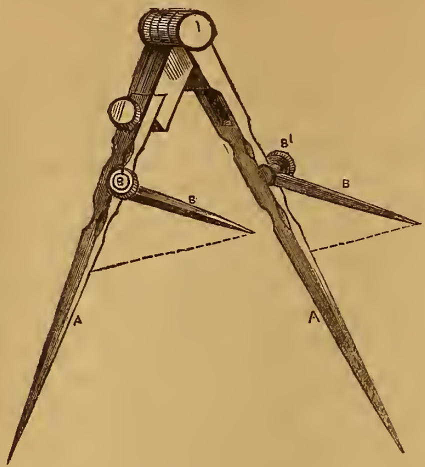


Fig. 2.

We have described this instrument as applied to the setting of circular saws, but it is equally well adapted to the straight saws. All that is necessary to fit it to the latter is the substitution of a screw furnished with a straight rest, in place of the screw, B.

The cheapness and simplicity of this invention, and its convenient adaptation to the setting of both circular and straight saws, ought to insure for it a very extensive introduction.—*Scientific American.*

New Drawing Instrument (By Henry M. Parkhurst, of Perth Amboy, N. J.)—In linear drawings of various kinds it is desirable for the artist to possess some convenient instrument whereby the scale of representation may be accurately changed, either by reduction or enlargement. Such instruments are known as Proportional Dividers; to this class the present improvement belongs.



Proportional Dividers are generally large, costly, and somewhat clumsy. But the invention here illustrated consists of a simple and inexpensive attachment to the common dividers. A A are the long legs to which the short legs, B, are attached, as shown. This constitutes the chief feature of the improvement. The short legs are fastened by adjusting the screws, B'.

Referring to the cut, it will be seen that the spread of the short legs is less than the long legs. In reducing a drawing the dimensions are measured with the long legs, and the short legs will indicate the reduced proportion. If a drawing is to be enlarged, the dimensions are taken with the short legs, when the increased size will be exhibited by the long legs. The proportions indicated will vary according to the angle given to the short legs. These may be set by a scale, if desired, the scale being attached at the point of junction of the short legs with the long ones. By turning the short legs down to the side of the others, these dividers may be used like a pair of the common kind.—*Scientific American.*

Smoke Prevention.—The Council of the Society of Arts have awarded to Mr. Charles Wye Williams, Assoc. Inst. C.E., the special gold medal, offered "For the best essay on the means of preventing the nuisance of smoke arising from furnaces and fires, which should treat the subject practically, reviewing the various plans which have been put forth as remedies, with the experience of their success or failure, and the results of their adoption as to expense or economy in erection and in working," &c.

Mr. Williams has treated the subject elaborately, and whilst not advancing any new theory of combustion, &c., he has not omitted to give prominence to his own plans. The frequent repetitions throughout the essay are objectionable, but are stated by the author to have been rendered necessary by the classification and arrangement of the several headings under which the subject was ordered to be treated by the Council of the Society of Arts, in the conditions published for the guidance of competitors for the prize offered.

The thorough ventilation of the subject in Mr. Williams' essay cannot but be productive of great benefit, by materially assisting the public in arriving at conclusions as to the value of a vast majority of the smoke-curing nostrums put forward.

Another patent plan for *extracting metals from their ores* has recently been brought before the public, by a company formed for working the invention of Messrs. Wagstaffe and Perkins, of the Chemical Manure Works, Isle of Dogs. By the use of chemical solvents and galvanic and other electro-metallurgic agency, they promise to thoroughly extract the various metals, in however minute quantities they may exist or be combined in the metallic ore, at a vast economy as compared with the cost of smelting, &c.

NOTICES TO CORRESPONDENTS.

Agricultural Mechanics, Improved Application of Steam, &c. We are sorry that we are compelled this month to omit the description, &c., of Mr. A. De Lacy's ingenious arrangements for steam culture.

R. S. N.—The second part of Mr. Murray's work on the "Stability of Retaining Walls" is not yet published. The Isthmus of Suez Question is receiving a considerable share of public attentiou; we were the first of the scientific press to notice M. Lesseps' work, and we have ever kept ourselves thoroughly informed of the progress of the proposed undertaking, and hope very shortly to lay before our readers some very important iuformation upou this subject.

H. M. (S. and Co.), Jamaica.—We saw Messrs. Blyth's new mill at work, and can recommend it. Send the address of your firm to us and we will communicate with Messrs. B. upon the subject. The Liverpool house you name are old established W. I. manufacturers, and a highly respectable firm. Of Bessemer's Patent Sugar Machinery we cannot inform you what is asked, but on receipt of your letter, stating where we can address you, we will make the inquiry.

A Young Amateur, Waterford.—1st. Spirits of salts is most frequently used for the purpose. Try it. 2nd. Jeffery's marine glue is the best thing for your purpose; be careful not to over-heat it when melting it for use—a common glue-pot, with oil in the outer pot, iustead of water, is a simple mode of reducing it. Melt it slowly, keep the air from it, use it thin and quite hot, see that the surfaces of the wood are quite clean, and the joint should stand. We have never found it fail for small purposes of the kind you describe. 3rd. Coat the surface of the model with black lead, and brush it in; when the metal is sufficiently hot pour it into the mould, having made suitable openings for the escape of the air. For your purpose you might put in a small tube or two at the side to give vent, and further free the air from the face by pricking. 4th. Yes; when over-heated poisonous vapours are given off—therefore, do not spoil your metal by over-heating it.

F. Robertson.—1st. Yes; there have been many attempts to introduce self-regulating apparatus for the excise-gauges employed at distilleries; we have seen several very ingenious contrivauces,—amongst them one by a Mr. Rudkin, who petitioned Parliament, and used very great exertions to induce the Government to adopt his invention; it is, however, about fifteen years ago—the excise authorities were opposed to any alteration, and Rudkin failed to get it adopted. 2nd. There are other objects to be attained besides measuring the quantity of spirits passed over the still-head, to make a complete instrument. It must combine an accurate timekeeper, connected with a sheet of ruled or divisioned paper, upon which to trace, by means of a pencil, a diagram, as in the steam-engine indicator; it should measure the quantity in half-pints, pints, quarts, and gallons, and should take a series of small samples at certain intervals of time: it should take and record the specific gravity and temperature of each sample, and the whole apparatus should be thoroughly secured from being interfered with.

C. Iles.—Messrs. Norton aud Co., Holland-street, have a very simple counter for registering the quantity of rope passed over a sheave. Mr. A. Smith, Princes-street, Haymarket, has a very excellent apparatus, which is used in the wire-rope machinery. How's counter, with clock, as exhibited at the Society of Arts, is, however, best suited for steam-engine duty registering, although it is a more expensive apparatus.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATION FOR PATENTS AND PROTECTION ALLOWED.

Dated 5th December, 1855.

2735. T. M. Fell, 49, Frederick-st., Gray's-inn-rd.—Ship's cooking and distilling apparatus, and the production of fresh water from sea water.

Dated 22nd December, 1855.

2899. J. Gedge, 4, Wellington-st. south, Strand—Cutting and folding paper for envelopes.

Dated 3rd January, 1856.

21. E. V. Neale, 4, Russell-pl., Fitzroy-sq.—Labels.

Dated 8th January, 1856.

57. C. L. Pariset, Paris—Paste for manufacturing paper, &c.
59. C. Pietroni, London-wall—Printing on cloth.

Dated 21st January, 1856.

157. J. C. Haddan, Cannon-row, Westminster—Omnibuses.

Dated 25th January, 1856.

197. F. Chauchard, Paris—Paper from vegetable substances.
203. J. Beads, Pendleton, Manchester—Machinery for spinning cotton, &c.

Dated 4th February, 1856.

295. A. Tolhausen, 7, Duke-st., Adelphi—Machinery for picking, carding, and combing fibrous substances.

Dated 5th February, 1856.

314. A. McDougall, Manchester—Treating bones, and other substances containing phosphates, for manure, &c.

Dated 7th February, 1856.

332. W. Kenworthy, Blackburn—Self-acting mules.

Dated 14th February, 1856.

377. J. C. Meyer, Paris—Machinery for rolling metal.

Dated 15th February, 1856.

391. E. Oldfield, Adelphi Iron Works, Salford—Self-acting mules.
393. E. Leach, J. Leach, and E. Leach, jun., Rochdale—Machinery for preparing, spinning, and drying yarns, and manufacturing the same into cloth.
395. E. Dobell, Hastings—Lamp glasses.
397. J. H. Johnson, 47, Lincoln's-inn-fields—Fountain pens.

Dated 16th February, 1856.

399. A. P. Rochette, Brighouse, near Huddersfield—Treating soap-suds to obtain products therefrom.
401. F. Parker, Halve, Trowbridge—Apparatus for affording exercise for the human body.
403. H. J. Hyams, Stanhope-st., Hampstead-rd.—Gas meters.

Dated 18th February, 1856.

404. W. W. Sleigh, London—Hydrostatic motive-power engine.
405. A. V. Newton, 66, Chancery-la.—Steam-engines.
407. H. Hodgkinson, Donegall-st.-pl., Belfast—Machinery for bleaching cotton and other fabrics.
409. M. Defries, Houndsditch—Supplying oil to the burners of lamps.

Dated 19th February, 1856.

411. W. H. Walenn, 68, Chancery-la.—Saw teeth.
413. S. E. Sichel, Bradford—Apparatus for weaving "ribbed" cloth and bands of cheuille.
415. W. H. Bowers, 4, Singleton-st. south, East-rd.—Railways.
417. J. Gedge, 4 Wellington-st. south, Strand—Curry-combs.
419. C. S. Jackson, Lieut., R.N. 18, Cannon-st., City—Preserving and disinfecting timber.
421. W. Savory and H. Arkell, Gloucester—Apparatus for the passage of water, &c.

Dated 20th February, 1856.

425. T. Smith and J. Gill, Hebden-bridge—Casing horizontal shafting.
427. J. Knowles, Eagley-bank, Bolton-le-Moors—Metallic pistons.

429. J. Gedge, 4, Wellington-st. south, Strand—Syphons.
431. J. Freer, Rothley, Leicester—An improved seed feeder and grain planting machines.
433. J. H. Johnson, 47, Lincoln's-inn-fields—Steam-engines.
435. J. Clark and J. Austin, 13, Moorgate-st.—Apparatus for stoppering bottles, jars, &c.
436. D. Auld and J. Stephen, Glasgow—Steam-boilers and furnaces, and apparatus connected therewith, and the consumption of smoke.
437. H. Sherwood, Esholt, near Leeds—Treating the "spun waste" of wool, cotton, silk, flax, hemp, and other fibrous substances, so as to render it suitable for re-working.
438. J. Barsham, Kingston-upon-Thames—Cases or packings for bottles and jars.
439. W. O. Johnston, Broomhill Colliery, Acklington, Northumberland, and J. Dixon, High-bridge Works, Newcastle-upon-Tyne—Cutting and working coal.

Dated 21st February, 1856.

441. L. A. Joyeaux, Marseilles—Motive-power.
443. W. Dawson, Otley—Machinery for cutting paper.
445. J. Gedge, 4, Wellington-st. south, Strand—Looms.
449. T. T. Chatwin and J. F. Chatwin, Birmingham—Buttons.
450. J. Diment, Bristol—Cements.
451. C. F. Dennet, Lansdowne-vils., Kensington-pk., and G. Pays, 260, Oxford-st.—Cartouche and percussion cap pouches.

Dated 22nd February, 1856.

453. F. W. Mowbray, Saltaire, Bradford—Machinery for spinning and doubling.
455. W. V. Wallace, Great Portland-st., and B. L. Sowell, Harrow rd.—Treating tobacco for cigars, and the manufacture of cigars from the tobacco so treated.
457. L. Bower, Birmingham—Machinery for the manufacture of screws.
458. W. Strang, Glasgow—Ornamental weaving.
459. G. Toucas, Paris—New metallic alloy.

Dated 23rd February, 1856.

463. D. Jones, Green-hill villa, Ragland, Monmouth—Motive-power.
465. S. Walsh and J. H. Brierley, Stannary Works, Halifax—Colouring and graining skins of leather on one side, and japanning them on the other side.
467. R. B. Jones, Limerick—Cooking apparatus.
469. J. Warburton, Addingham, near Otley—Machinery for combing wool, &c.
471. W. Sangster, 75, Cheapside—Umbrellas and parasols.
473. C. Brook, jun., Meltham Mills, Huddersfield, and J. Hirst, Wilshaw, Huddersfield—Finishing yarns of wool, &c.

Dated 25th February, 1856.

475. B. J. Heywood, Dublin—Improved holder for leads, and other marking materials, applicable also as a case for other articles.
477. J. Murgatroyd, Heaton Norris—Steam-boilers.
479. C. Iles, Birmingham—Pointing hair pins, and making up hair pins for sale.
483. J. Marzolo, Padua—An impressible mechanism, reproductive of movements applicable to weaving looms, &c.

Dated 26th February, 1856.

485. J. Barrow, jun., Manchester—Manufacture of soda, sulphurous and other sulphuric acids, and apparatus used therein.
487. S. Henn and T. Haddon, Gibb-st. Works, Birmingham—Mode of forming the heads of ornamental nails, when such heads are formed of a different metal or metals from the shanks.
488. G. Coats, Glasgow—Partitions or "brattices" for coal mines and underground works.
489. F. R. Penor, Darmstadt—Looms for weaving.
491. J. Cornes, Swan-la.—Machines for washing and churning.
493. F. Thompson, Sheffield—Skates.
495. G. Parry, Ebbw Vale Iron Works, Monmouth—The puddling and refining of iron.
497. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Power-looms.

Dated 27th February, 1856.

499. P. A. Fontaine Moreau, 39, Rue de l'Echiquier, Paris—Cicatrising preparation.
501. W. H. Jennings, Birmingham—Guards and heel plates of guns.
503. E. E. Allen, 376, Strand—Permanent way of railways.
505. T. T. Jopling, Bishop's Wearmouth—A water meter.

Dated 28th February, 1856.

506. F. P. Walker, Manchester—Machinery for cutting vegetable substances.
507. W. Thompson and C. Wilson, Birmingham—Buttons, and attaching them to articles of dress.
508. J. Smith, Derby—Water-gauges for boilers.
509. I. Westhorp, London—Concentrating milk, and obtaining concentrated extracts from tea, &c.
510. P. D. Margesson, Woolwich—Manufacture of iron from iron ores.
511. C. Frow, Wakefield—Furnaces for steam-boilers, &c.
512. J. Fowler, jun., Havering, Romford, and D. Greig, Barkingside—Ploughing and tilling land.
513. E. T. Archer, Cedar-cottage, Wandsworth—Envelopes for the transmission of letters, &c.
514. C. A. de Fonbonne, Paris—Manufacture of coke for blasting, also for the production and extraction of illuminating and combustible gas, as well as ammoniacal and bituminous matters, part of such apparatus being applicable to the consumption of smoke.
515. P. L. Grosrenaud, St. Etienne—Furnaces for melting and puddling metals.
516. R. A. Brooman, 166, Fleet-st.—Treating bituminous shale, and other like schistous bodies, to obtain products therefrom.

Dated 29th February, 1856.

517. J. Logan, Liverpool—Pumps, especially applicable to bilge pumps on board ships.
518. J. Brierley, Blackburn—Machinery for twisting and doubling yarns for mule banding, &c.
519. J. Markett, Lieut., R.N., Hastings—Manufacture of envelopes.
520. J. Graham, Aughton, Lancaster—Cleaning and dressing rice and other grain.
521. J. Greenwood, Rawden, Leeds—Heating water for the supply of steam-boilers.
522. E. Connor, Belfast—Looms for weaving.
523. C. Barlow, 89, Chancery-la.—Machinery for cutting cloth and textile fabrics.
524. W. A. Turner, 125, Wood-st., Cheapside—Manufacture of elastic tubing.

Dated 1st, March 1856.

526. W. Clark, Upper-ter., Islington—Cutting or shaping trowsers.
527. R. F. Miller, Hammersmith—Improved omnibus.
528. J. Reading, Birmingham—Attaching watch-keys, seals, watches, &c., and ornamental articles of dress in general to chains, and the catches of brooches.
529. H. A. Dewar, Aberdeen—Conveying motion for mechanical operations.
530. J. H. Johnson, 47, Lincoln's-inn-fields—Looms for weaving.
531. P. R. Hodge, 4, Albion-grove, Islington—Method of lighting domestic fires.
532. L. tborck, 74, Montagne-de-la-Cour, Brussels—Locomotive and other tubular boilers.
533. A. Francis, Enscomb-ter., Wandsworth-rd.—Manufacture of a composition as a cement, &c.
534. F. Kaselowsky, Bielefeld, Prussia—Winding yarns and thread of flax in spinning machines.
535. C. M. Tessié du Motay, 24, Rue Fontaine St. George, Paris, and J. J. Fontaine, 19, Rue Paradis-Poissonnière, Paris—Treating cast-iron.
536. W. Chapman and J. H. Teager, Ipswich—Apparatus for cooking animal and vegetable substances, and for heating steam closets.
537. F. Rualem, 29, Rue de Paris à Belleville, France—Manufacture of fuel.

Dated 3rd March, 1856.

538. R. Maynard, Whittlesford—Machinery for cutting and separating agricultural produce.
539. A. Oppenheimer, Manchester—Machinery for stretching velvets, &c., and for cutting the pile of such goods.
540. J. Wallace, jun., Glasgow—Bleaching, washing, cleansing, and drying textile fabrics and materials.
541. J. Homan, Milk-st., Cheapside—Driving sewing-machines.
542. J. Aspinall, Limehouse—Machinery for curing sugar, or extracting moisture therefrom, and separating liquids from solids.
543. J. E. Hodges, Leicester—Machinery for the manufacture of looped and textile fabrics.
544. J. Venables, Burslem—Ornamenting articles made of clay and other plastic materials.
545. J. E. Hodges, Leicester—Machinery for the manufacture of looped fabrics.

Dated 4th March, 1856.

546. E. Poitiers, 12, Maldon-ter., Haverstock-hill—A new material or materials for the manufacture of brushes, and the manufacture of street scavengers' brooms or brushes.
547. L. Coddé, M.D., 39, Rue de l'Echiquier, Paris—Submarine communication.
548. R. A. Brooman, 166, Fleet-st.—Fabric for ladies' garments
549. T. Lambert, New-cut, Lambeth—Apparatus for regulating the drawing off of water, &c.
550. C. T. Rosenberg, 12, Clarence-ter., Camberwell New-rd.—Ornamenting china, glass, &c.
551. M. Samuelson, Scott-st., Hull—Screw propellers.
552. J. Platt, Oldham—Machinery for spinning and winding cotton, and other fibrous materials.
553. G. Lodge, sen., J. Ogden, and G. Lodge, jun., Leeds—Apparatus for effecting the consumption of smoke in steam-boilers, &c.

Dated 5th March, 1856.

554. S. Clegg and J. Kay, Padiham, near Burnley—Machinery for warping yarns.
555. R. Dugdale Kay, Accrington—Fabrics from fibrous materials.
556. W. Billington, Great George-st., Westminster—Method of treating wooden railway sleepers.
557. S. Last, Oxford-st.—Trunks or portmanteaus, and their locks.
558. C. Morgan, Cwm Aman, near Llanelly, and C. R. Vickerman, Kilgetty, near Saundersfoot, Pembroke—Preparation of fuel for steam-boiler purposes.
559. W. Green, York-st., City-rd.—Ornamenting and waterproofing fabrics.

Dated 6th March, 1856.

560. T. B. Sharp and T. Forsyth, Atlas Works, Manchester—Coupling railway rolling stock.
561. L. D. Jackson, 3, Alfred-pl., Alfred-rd., and H. Myers, 51, Alfred-rd., Paddington—Combining air and water as a power.
562. H. D. Pochin, Salford—Manufacture of aluminous and siliceous compounds.
563. R. Philp, Suffolk-parade, Cheltenham—Paddle-wheels.
565. R. Morrison, Newcastle-upon-Tyne—Pile-driving machinery.
566. B. Browne, Stockwell—Spindles for locks for latches.
567. A. Neuburger, 39, Rue de l'Echiquier, Paris—Oil from a vegetable substance not hitherto so used.
568. J. W. Scott, Worcester—Fastening buttons.
569. R. A. Brooman, 166, Fleet-st.—Method of creating a vacuum, with certain arrangements for preserving substances liable to injury from prolonged exposure.

Dated 7th March, 1856.

570. J. Downie, Glasgow—Moulding or shaping metals.
571. C. G. Hahner, Leghorn—Treatment of ores.
572. D. Brown and W. Brown, Smethwick—Rolling railway switches from railway bars, and rolling taper ends, &c.
573. F. H. Holmes, London—Machines known as magneto-electric machines.

Dated 8th March, 1856.

574. T. Cook, Lieut., R.N., Addiscombe—Portable bedsteads.
575. H. B. Young, Barnstaple—Steam-engines.
576. H. Cooke, Manchester—Machinery for dyeing and dressing yarns, &c.
577. J. J. Robert, 18, Portugal-st., Lincoln's-inn-fields—Extracting the greasy particles from water after cleansing wools, by the means of sulphate of zinc, &c.
578. D. Y. Stewart, Glasgow—Moulding metals.

Dated 10th March, 1856.

579. R. Hannah, Glasgow—Pottery kilns.
580. L. C. and A. Hennique, 39, Rue de l'Echiquier, Paris—Ornamenting ceramic and vitreous products.
581. P. D. Nolet, Rue de la Lune, Paris—Pen-holders.
582. P. H. G. Bèrard, Paris—Artificial flowers and foliage.
583. R. S. Bartleet, Redditch—Needle cases or holders.
584. J. Mills, Oldham—Spindles used in cotton machinery.
585. F. J. Emery, Cobridge—Means of arresting the descent of cages or corves in shafts of mines.
586. J. Davy, Manningham, Bradford, and J. Milnes, Clayton West, Huddersfield—Looms for weaving plaids, &c.

Dated 11th March, 1856.

587. A. Tolhausen, 7, Duke-st. Adelphi—Bakers' ovens.
589. H. Greene, Windlesham, Bagshot—Locomotive-engines and carriages.
590. O. Maggs, Bourton Foundry, Dorset—Straw shaking apparatus of threshing machines.
591. H. Petitpierre, 15, Avenue de St. Ouen, Batignolles, Paris—Sawing or cutting stone.
592. J. Fowler, jun., Havering, Romford—Bricks and tiles.

Dated 12th March, 1856.

593. H. Horner and R. Bagley, Sheffield—Buffers, draw, and bearing springs.
594. G. Spencer, 6, Cannon-st.—Supporting the rails of railways.
595. J. M. Stanley, G. Bellamy, and W. Booth, Sheffield—Manufacture of rolls for rolling steel or other malleable material.
596. C. R. N. Palmer, Strand—New telegraph and improved telegraph apparatus, parts of the invention being applicable to other purposes.
597. J. Vigars, Marytavy, Tavistock—Machinery for lifting in mines, also applicable to other purposes.
598. E. A. Pontifex, Shoe-la.—Manufacture of tartaric and citric acids, and tartrate of potash and soda.
599. L. M. Chalange, Nogent-sur-Seine, France—Corn-mills.
600. W. Corbitt and G. Shaw, Masbro' Works, Rotherham—Buffer-bearing and draw springs for railway and other carriages.
601. F. H. Edwards, Newcastle-upon-Tyne—Railway breaks.
602. W. B. Hayes, Manchester—Looms for weaving.
603. J. N. Ryder, Thames-st.—Slide-valves of steam-engines.
604. G. Murray, Whitehill-point, Northumberland—Manufacture of wheels for locomotive-engines, waggons, and carriages to be used on railways.
605. T. W. Taylor, Canneltou, Perry, U.S.—Flying or roving frames.

Dated 13th March, 1856.

607. P. H. G. Bèrard, Paris—Manufacture of waterproof fabrics, may also be applied for rendering other substances waterproof.
608. J. Sturge, Kennington, and A. Sturge, Northfleet—Rotary fluid meters.
609. G. Rees, Clerkenwell—Producing ornamental surfaces on glass.
610. I. Dixon, Liverpool—Propeller for steam ships and other vessels.
611. G. de Chateauneuf, 39, Rue de l'Echiquier, Paris—A hydropneumometric gas meter.
612. T. Porter, Manchester—Looms for weaving carpets.
613. J. Murdoch, 7, Staple-inn—Manufacturing cut velvets and other similar fabrics.

Dated 14th March, 1856.

615. P. Pimont, Rouen—Process for restoring metallic spoiled pens.
616. C. D. Gardissal, 10, Bedford-st., Strand—Capstans.
617. C. D. Gardissal, 10, Bedford-st., Strand—Ships' windlasses.

618. P. Marcus, Well-st. — Apparatus for working the damper in steam-engine furnaces.
619. W. Yates, Bromley, Middlesex—Furnaces.
620. W. Clay, Liverpool—Manufacture of the points or switches and crossings of railways.
621. W. E. Newton, 66, Chancery-la. — Machinery for separating gold and other metals from their ores.

Dated 15th March, 1856.

622. C. Coates, Sunnyside, Rawtenstall — Apparatus for communicating motion to machinery used in bleaching and finishing fabrics.
623. L. J. Richard, Tirlemont, Belgium—Sugar manufacture.
624. J. B. Hawkins, Reading—Couches or sofas, applicable to other like furniture.
625. E. T. Wright, Wolverhampton — Manufacture of steam-engine boilers, iron ships and boats, and other vessels and things as are made by rivetting metal plates.
626. R. W. Winfield, Birmingham, J. Simms, Fleet-st., and T. Lloyd, King's Norton—Construction and ornamentation of metallic bedsteads and articles of metallic furniture.
627. J. Rice, Foley-pl., and W. Rice, Lieutenant H.E.I.C.S. Breech-loading repeating guns and rifles.
628. J. Dumas, Marseilles—Tiles.
629. W. Oldham, Southam, Warwick—Cement.
630. H. Bessemer, Queen-st.-pl., New Cannon-st.—Manufacture of iron and steel.
631. C. Randolph and J. Elder, Glasgow—Marine engines.
632. J. Pegg, Monk Wearmouth—Steering apparatus.

Dated 17th March, 1856.

633. J. Mitchell, Dunning's-al., Bishopsgate-st. without—Apparatus for washing and amalgamating ores, &c.
634. G. Hills, Belmont-hill, Lee—Treating fatty and oily substances.
635. C. B. Normand, Havre—Treatment and employment of steam in engines, and apparatus for the condensation of steam.
636. J. Amos, Frindsbury, Kent—Flour dressing machine.
637. T. Palmer, Tavistock—Pumps, with a new valve.
638. R. Thomson, Glasgow—Weaving.
639. W. Graham, Glasgow—Marine compasses, and adjusting them on board ship.

Dated 18th March, 1856.

640. P. A. Le Comte de Fontaine Moreau, Paris—Churns.
641. P. de Praeds, Camden New-town—Wheelbarrows.
642. T. Bird and T. Rose, Manchester—Castors.
643. E. Rowley, West Bromwich, and J. Hadley, Birmingham—Shaping iron.
644. E. Pettitt, Manchester—Machinery for fibrous substances.
645. J. Drury, Paddock, Huddersfield—Steam-boilers for preventing explosion.
647. H. Barber, Belgrave, Leicester—Manufacture of hosiery.
648. W. Smith, 10, Salisbury-st., Adelphi—Economising heat in locomotive-engines.
649. P. Appleton, 7, London-st., New Swindon—Knives for peeling apples, fruits, &c.

Dated 19th March, 1856.

651. R. Morgan, Acton—A cellular purse.
652. T. Richardson and G. W. Jaffreys, Hartlepool—Marine steam-engines.
653. A. D. Lacy, Hall-house, Knayton, Thirsk—Apparatus for taking up and delivering mail bags and other packages from a railway carriage or carriages whilst the train is in motion.
654. B. S. Cohen, 9, Magdalen-row, Gt. Prescot-st.—Chimney-pieces, and ornamental parts of buildings.
655. J. D. M. Stirling, Blackgrange, Clackmannanshire—Steel and its manufacture.
656. B. S. Cohen, 9, Magdalen-row, Gt. Prescot-st.—Penholders, handles, knobs, finger-plates, and umbrella and parasol furniture.
657. E. S. Stott, Halifax—Mohair, alpaca, and worsted pile fabrics.
658. D. Cope, Birmingham—Spoons, forks, and ladles.
659. A. V. Newton, 66, Chancery-la.—Means for separating substances of different specific gravities.
660. J. B. Hall, New York—Preparing and treating pictures.
661. C. F. Parsons, Lambeth—Machinery to be employed in the bleaching and dyeing of cloths, &c.
662. R. A. Brooman, 166, Fleet-st.—Balance slide-valves.

Dated 20th March, 1856.

663. J. Leighton, 40, Brewer-st., Golden-sq.—A luminous fire-place, and self-supplying smoke consumer.
664. P. A. le Comte de Fontaine Moreau, 4, South-st., Finsbury—Looms for weaving.
665. J. Wadsworth, Hazelgrove, Stockport—Ventilation of mines, or means of removing noxious gases therefrom, and in machinery for that purpose.
666. J. W. Burton, Eye, Suffolk, and G. Pye, Ipswich—Treating flax, hemp, and other matters requiring like treatment.
667. W. C. T. Schaeffer, Bradford—Treating soap-suds and wash-waters.
668. J. D. M. Stirling, Blackgrange, Clackmannanshire, N.B.—Mounting heavy ordnance for naval purposes.
669. J. Trueman, 34, Castle-st., Belfast—Ovens for baking.
670. W. Drummond, Smith-st., King's-rd., Chelsea—Spring hinges for swing doors.

Dated 22nd March, 1856.

671. J. Murphy, Newport—Means for stopping vehicles used on rail or other roads, also applicable to the break wheels in stationary engines.
672. G. H. Brookes, Dalkeith—Stoves, grates, &c.
673. W. Brierley and J. P. Brierley, Cleckheaton—Looms for weaving.
674. W. Glover, Salford, Manchester—Construction of machinery for damping and beetling woven fabrics.
675. H. Pratt, Worcester—Construction of union mills, application of the motive-power apparatus, and machinery connected with the manufacture of flour and bread, also applicable for other useful purposes.
676. J. S. Cockings, 36, Ann-st., Birmingham—Envelope, which envelope he proposes designating the "Despatch Envelope."
677. J. H. Johnson, 47, Lincoln's-inn-fields—Weaving by electric power, and machinery employed therein.
678. J. J. and A. C. Shirreff, Glasgow—Construction and application of rotary motive-power engines, &c.
679. J. H. Johnson, 47, Lincoln's-inn-fields—Electro-magnetic printing telegraphs.
680. H. Brierley, Chorley—Self-acting mules for spinning and doubling.
681. J. Hinks and G. Wells, Birmingham—Metallic pens and pen-holders.
682. G. G. A. L. M. Schelhorn, Birmingham—Pen-holder.
683. C. Carey, 32, Union-grove, Wandsworth-rd.—Shower baths.
685. C. Carey, 32, Union-grove, Wandsworth-rd.—Vessels and filters used for making infusions of coffee, &c.
686. J. Juckes, Dame-st., Islington—Furnace bars.
687. C. Carey, 32, Union-grove, Wandsworth-rd.—Presses for copying letters and other documents, &c.
688. E. Barber, Tring, Hertfordshire—Mangles.

Dated 24th March, 1856.

690. T. Heaton, Blackburn—Self-acting doors and gateways.
691. J. Bryant, jun., Plymouth—Machinery or apparatus for the re-burning of animal charcoal.
692. J. Robertson, Ardrossan—Transmitting motive-power.
694. P. Brown and G. Brown, Liverpool—Ash-pan for fire-grates.
695. R. Husband, Manchester—Manufacture of hats.
696. J. Tysoe, C. Tysoe, and P. Foxcraft, Salford—Machinery for roving and doubling cotton, &c.
697. W. Pitt and E. T. Davies, Birmingham—Manufacture of brackets and castors for furniture.
698. W. Clay, Liverpool—Manufacture of wrought or bar iron.
699. W. E. Newton, 66, Chancery-la.—Coupling for connecting carriages, and all vehicles used on railways.
700. W. E. Newton, 66, Chancery-la.—Cranes.

Dated 25th March, 1856.

701. R. Caunce, Bolton-le-moors—Machines for spinning called "Mules."
702. J. Bromley, Shelton, and W. Adams, Etruria—Ovens for firing porcelain and earthenware.
703. L. A. Gizard, 33, Rue de l'Echiquier, Paris—Elastic mattresses and cushions.
704. J. Aspinall, Limehouse—Apparatus for obtaining extracts, &c.
705. W. Forster, Black Dike Mills, Bradford—Looms for weaving.
706. J. H. Johnson, 47, Lincoln's-inn-fields—Machinery for raising nap or pile.
707. J. D. Dunnicliffe, Nottingham, and S. Bates, Radford, Nottingham—Manufacture of twist lace and weavings.
708. G. H. Cottam and H. R. Cottam, Old St. Pancras-rd. —Manufacture of chairs and articles to sit on.
709. J. Hargraves, Woollen Works, Carlisle—Apparatus used for dyeing fabrics.
710. G. H. Smith, North Perrot, Crewkerne—Manufacture of saucepans and culinary utensils.
711. W. Ball, Chicopee, Hampden, U.S.—Machinery for stamping ores.
712. R. Collins, Trent—Agricultural implement.
713. W. Illingworth, Manchester—Printing china, or other ceramic manufactures, and machinery connected therewith.
714. G. Wailes, 10, Palace-row, New-rd.—Actuating valves used for regulating the passage of gas or water in pipes.

Dated 26th March, 1856.

715. M. Weston and O. Carter, Rochdale—Machinery for setting saws.
716. J. Liley, 5, Gutter-la.—Case or sliding-tube for candles, telescopes, opera-glasses, especially applicable to portable articles for the toilet, called "Debas-cylindrical-etui."
717. A. Tolhausen, 7, Duke-st., Adelphi—Process of producing chemical writing, and of marking chemically any characters or figures upon paper, &c.
718. A. Tolhausen, 7, Duke-st., Adelphi—Mode of manufacturing porous earthenware.
719. W. A. Gilbee, 4, South-st., Finsbury—Manufacture of glass.
720. T. B. Daft, Seville Iron Works, Dublin—Manufacture of metallic bedsteads and metallic furniture.
721. D. Lowe, Leicester—Knitting machinery.
722. G. Smith, 9, Manor-rd., Newington—Envelopes for containing letters, &c.
723. P. S. Rankin, Glasgow—Communicating motive-power.
724. W. R. Barker, Chapel-st., and W. Toogood, Mount-st.—Bottles, or in stoppering bottles and other receptacles.
725. J. Rock, jun., Hastings—Carriages, applicable to other structures.
726. W. E. Newton, 66, Chancery-la.—Apparatus for exploring under water.
727. W. Clayton, Watling-st.—Manufacture of soap.
728. W. E. Newton, 66, Chancery-la.—Macerating substances to be employed in distillation.

Dated 27th March, 1856.

729. J. Taylor and J. Galloway, Bolton-le-Moors—Gauges for indicating pressure.
730. A. Tolhausen, 7, Duke-st., Adelphi—Watches and other time keepers.
731. J. Tall, Islington—Blind rollers, and fixings for the same.
732. W. Nicholls, Raunds, Northampton—Manufacture of boots, &c.
733. R. D. Cumming, St. James's, Middlesex—A foot-stool and hassock combined.
734. B. F. Brunel, Hampstead-rd.—Manufacture of Prussian blue.
735. J. Cliff, Burton-upon-Trent—Machinery for cleansing casks.
736. W. Ball, Chicopee, Hampden, U.S.—Machines for separating copper, &c., from their ores.
737. A. L. Hill, Birmingham—Furnaces for steam-boilers and other purposes.
738. E. Bufton, 122, Piccadilly—Ink for marking linen, &c., case for containing the same, and implements to be used therewith.
740. W. F. Thomas, St. Martin's-le-Grand—Sewing-machines.

Dated 28th March, 1856.

741. J. A. Barratt, 39, Rue de l'Echiquier, Paris—Rotatory steam-engine.
742. J. C. Meyer, Paris—Vices.
743. W. Ward, Warrington—Apparatus for lubricating the spindles of certain machines, and in preparing and spinning.
744. A. Daniel, Moorfields, Wolverhampton—Manufacture of keys and locks.
745. J. Webber, Torquay—Generating steam.
746. J. Charritie, Cannon-st., and W. Smith, 10, Salisbury-st., Adelphi—Manufacture of small shot.
747. J. Harrison, Geelong, Victoria—Producing cold by the evaporation of volatile liquids in vacuo, the condensation of their vapours by pressure, and the continued re-evaporation and re-condensation of the same materials.
749. J. Harrison, Geelong, Victoria—Distilling or evaporating in vacuo, condensing the vapour by pressure, and economising heat.
750. A. Trueman, Swansea—Treating argentiferous regulus.
751. A. V. Newton, 66, Chancery-la.—Air-engine for producing motive-power by heated air.

Dated 29th March, 1856.

753. C. W. Williams, Liverpool—Application of air-propelling or exhausting apparatus for ventilating on board steam-vessels.
755. F. Puls, Soho-sq.—Galvanic batteries.
757. R. Powell, 2, Peter's-pl., St. Martin's-la.—A new method of making up cotton and other textile fabrics, whether waterproofed or not, into wearing apparel, by which method the article when made up is perfectly ventilated.
759. W. Muschamp, Tyne Paper Mill Company, Gateshead —Manufacture of paper in order to render it waterproof.
761. J. McLean, Glasgow—Preparing textile fabrics for increasing the density thereof.
763. W. Nimmo, Pendleton—Manufacture of textile fabrics.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

614. W. McCarton, 21, Clarence-pl., Dublin—Drying of corn or grain for grinding, &c., and apparatus for performing same, applicable to drying seeds.—13th March, 1856.
650. L. Ochs, St. Josse ten Noode, Belgium—Manufacture of paper from the refuse of tanned leather.—19th March, 1856.
739. C. J. Dumery, Paris—Smoke-preventing apparatus.—27th March, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.
March 15, 3818. C. and J. Clark, Street, near Glastonbury, "Boot."
„ 18, 3819. J. Morris and Sons, Astwood-bank, near Redditch, "Synoptical Needle Case."
„ 20, 3820. W. Heap, Oldham-rd., Ashton-under-Lyne, "Heap's Improved Pipe and Nut Wrench."
„ 25, 3821. F. Cornwall, Hanley-st., Birmingham, "An Improved Grate for Heating, Ventilating, and Economising Coals."
„ 28, 3822. Negretti and Zambra, Hatton-garden, "Glass Instrument for Measuring the Density of Fluids."
„ 28, 3823. C. Ford, Hanley, "Portable Heater or Boiler."
April 3, 3824. Ransomes and Sims, Ipswich, "Frame or Stand of a Mill."
„ 8, 3825. E. Smith and Sons, and J. Smith and Sons, Leeds, "The 'Carlisle' Morning Coat."
„ 10, 3826. E. Edwards, Birmingham, "Insect Trap."
„ 12, 3827. R. Pease, Bradford, Yorkshire, "Improved Pressure-gauge."
„ 15, 3828. J. Lowe and M. Pollock, Birmingham, "Guard for Penholder."
„ 16, 3829. J. Manuel, Sheffield, "Reclining Chair"

under the boiler per hour by 12, and divide the product by the square root of the height of the chimney in feet,—the quotient is the area of the chimney in square inches in the smallest part. A factory chimney, suitable for a 20-horse boiler, is commonly made about 20 inches square inside, and 80 feet high; and these dimensions are those which answer to a consumption of 15 lb. of coal per H.P. per hour, which is a very common consumption in factory engines. If 15 lb. of coal be consumed per H.P. per hour, the total consumption per hour in a 20-horse boiler will be 300 lb.; and 300 multiplied by 12 = 3,600, and divided by 9 (the square root of the height) = 400, which is the area of the chimney in square inches."

In slow working engines the area of the steam passages should be one twenty-fifth of the area of the cylinder, and in locomotives about one-eighth. The area, which it appears advisable to give, is somewhat in excess of the present practice, and is expressed by the following rule:—Multiply the area of the cylinder in square inches by the speed of the piston in feet per minute, and divide the product by 4,000,—the quotient is the area of each cylinder port in square inches. Air vessels may be applied with advantage to the *suction* side of fast moving pumps. To compute the dimensions of a malleable iron paddle-shaft so that the strain shall not exceed five-sixths of the elastic force, or the strain iron is capable of withstanding without permanent derangement of structure, which in tensile strains is taken at 17,800 pounds per square inch, multiply the pressure in pounds per square inch on the piston by the square of the diameter of the cylinder in inches, and extract the cube root of the product, which, multiplied by 0·08264, will be the diameter of the paddle-shaft journal in inches when of malleable iron, whatever the pressure of the steam may be. Angle iron should not be used in the construction of boilers, as it becomes reedy in the manufacture and is apt to split; it is safer to bend the plates, which should be of Lowmoor iron, in easy curves. No excuse should be accepted for the formation of scale in boilers, as it may always be prevented by blowing off. Although a large proportion of the feed water may be blown out, the loss of heat is not very great.

"Boilers are sometimes worked at a saltness of $\frac{4}{33}$rds, and taking this saltness and supposing the latent heat of steam to be at 1,000° at the temperature of 212°, and reckoning the sum of the latent and sensible heats as forming a constant quantity, the latent heat of steam at the temperatnre of 250° will be 962°, and the total heat of the steam will be 1,212° in the case of fresh water; but as the feed water is sent into the boiler at the temperature of 100°, the accession of heat it receives from the fuel will be 1,112° in the case of fresh water, or 1,112° increased by 3·98° in the case of water containing $\frac{4}{33}$rds of salt—the 3·98° being the 4·7° increase of temperature due to the presence of $\frac{4}{33}$rds of salt, multiplied by 0·847 the specific heat of steam. This makes the total accession of heat received by the steam in the boiler equal to 1,115·98°, or say 1,116°, which, multiplied by 3 (as three parts of the water are raised into steam) gives us 3,348° for the heat in the steam, while the accession of heat received in the boiler by the one part of residual brine will be 154·7°, multiplied by 0·85, the specific heat of the brine, or 130·495°; and 3,348° divided by 130·496° is about $\frac{1}{26}$th. It appears, therefore, that by blowing off the boiler to such an extent that the saltness shall not rise above what answers to $\frac{4}{33}$rds of salt, about $\frac{1}{26}$th of the heat is blown into the sea: this is but a small proportion; and as there will be a greater waste of heat, if from the existence of scale upon the flues the heat can be only imperfectly transmitted to the water, there cannot be even an economy of fuel in niggard blowing off, while it involves the introduction of other evils. The proportion of $\frac{4}{33}$rds of saltness, however, or 16 oz. to the gallon, is larger than is advisable, especially as it is difficult to keep the saltness at a perfectly uniform point, and the working point should, therefore, be $\frac{2}{23}$rds as before prescribed."

The single-acting pumping-engine is a remnant of engineering barbarism, which must be superseded by more compendious contrivances. The Cornish engine, though rudely manufactured, is expensive in production, and does but little work for its size; whereas, by employing a smaller engine moving with a high speed, the dimensions may be so far diminished that the most refined machinery may be obtained at less than the present cost. The present large duty is owing to the extensive development of the principle of expansion which may be as well applied in other cases. The oscillating-engine is preferred for side wheel marine engines; and the horizontal cylinder-engine, with double piston-rods working backwards to the crank with the connecting rod, like those of the *Amphion*,* is preferred for screws. The great objection to the trunk-engine is the radiation. The pistons of double-acting air-pumps should leave no vacant space in the ends of the barrels and connexions when at the termination of the stroke.

"488. *Q.*—Will you explain the method of putting engines into a steam-vessel?

"*A.*—As an illustration of this operation it may be advisable to take the case of a side lever-engine, and the method of proceeding is as follows:—First, measure across from the inside of the paddle bearers to the centre of the ship, to make sure that the central line, running in a fore and aft direction on the deck or beams, usually drawn by the carpenter, is really in the centre. Stretch a line across between the paddle bearers in the direction of the shaft; to this line, in the centre of the ship where the fore and aft mark has been made, apply a square with arms six or eight feet long, and bring a line stretched perpendicularly from the deck to the keelson, accurately to the edge of the square: the lower point of the line where it touches the keelson will be immediately beneath the marks made upon the deck. If this point does not come in the centre of the keelson, it will be better to shift it a little, so as to bring it to the centre, altering the mark upon the deck correspondingly, provided either paddle-shaft will admit of this being done—one of the paddle brackets being packed behind with wood, to give it an additional projection from the side of the paddle bearer. Continue the line fore and aft upon the keelson as nearly as can be judged in the centre of the ship; stretch another line fore and aft through the mark upon the deck and look it out of winding with the line upon the keelson. Fix upon any two points equally distant from the centre, in the line stretched transversely in the direction of the shaft; and from those points, as centres, and with any convenient radius, sweep across the fore and aft line to see that the two are at right angles; and, if not, shift the transverse line a little to make them so. From the tranverse line next let fall a line upon each outside keelson, bringing the edge of the square to the line, the other edge resting on the keelson. A point will thus be got on each outside keelson perpendicularly beneath the transverse line running in the direction of the shaft, and a line drawn between those two points will be directly below the shaft. To this line the line of the shaft marked on the sole plate has to be brought, care being taken, at the same time, that the right distance is preserved between the fore and aft line upon the sole plate, and the fore and aft line upon the central keelson.

"489. *Q.*—Of course the keelsons have first to be properly prepared?

"*A.*—In a wooden vessel, before any part of the machinery is put in, the keelsons should be dubbed fair and straight, and be looked out of winding by means of two straight edges. The art of placing engines in a ship is more a piece of plain common sense than any other feat in engineering, and every man of intelligence may easily settle a method of procedure for himself. Plumb lines and spirit levels, it is obvious, cannot be employed on board a vessel, and the problem consists in so placing the sole plates, without these aids, that the paddle-shaft will not stand awry across the vessel, nor be carried forward beyond its place by the framing shouldering up more than was expected. As a plumb line cannot be used, recourse must be had to a square; and it will signify nothing at what angle with the deck the keelsons run, so long as the line of the shaft across the keelsons is squared down from the shaft centre. The sole plates being fixed, there is no difficulty in setting the other parts of the engine in their proper places upon them. The paddle-wheels must be hung from the top of the paddle-box to enable the shaft to be rove through them, and the cross stays between the engines should be fixed in when the vessel is afloat. To try whether the shafts are in a line, turn the paddle-wheels, and try if the distance between the cranks is the same at the upper and under, and the two horizontal centres; if not, move the end of the paddle-shaft up or down, backwards or forwards, until the distauce between the cranks at all the four centres is the same."

Upon well-formed railways, with carriages of good construction, the average tractive force required for low speeds is about 7½ lb. per ton, or $\frac{1}{300}$th of the load, though in some experimental cases, where particular care was taken to obtain a favourable result, the tractive force has been reduced as low as $\frac{1}{500}$th of the load. The amount of adhesion of the wheels of a locomotive upon the rails is about 1-5th of the weight when the rails are clean: but when they are half wet or greasy the adhesion is not more than 1-10th or 1-12th of the weight upon the wheels. The cost of a common narrow gauge locomotive of average power varies from £1,900 to £2,200; it will run, on an average, 130 miles per day, at a cost for repairs of 2½d. per mile; and the cost of locomotive power, including repairs, wages, oil, and coke, does not exceed 6d. per mile when economically managed. The tires are turned somewhat conical, to facilitate the

* See The Artizan, Vol. 1853, Plate II.

passage of the engine round curves—the diameter of the outer wheel being virtually increased by the centrifugal force of the engine, and that of the inner wheel being correspondingly diminished, whereby the curve is passed without the resistance which would otherwise arise from the inequality of the spaces passed over by wheels of the same diameter fixed upon the same axle. The rails, moreover, are not set quite upright, but are slightly inclined inwards, in consequence of which the wheels must be either conical or slightly dished, to bear fairly upon the rails.

The resistance of vessels in water and the structure and advantages of paddle-wheels and screws are fully discussed in the ninth chapter. The resistance of vessels varies as the square of the velocity, or nearly so; and the power necessary to impart an increased velocity varies nearly as the cube of such increased velocity. To double the speed of a steam-vessel, therefore, will require four times the tractive force; and as the quadrupled force must act through twice the distance in the same time, an engine capable of exerting eight times the original power will be required. A very sharp bow has the effect of enabling the vessel to move through a great distance while the particles of water are moved aside but a small distance; or, in other words, it causes the velocity with which the water is moved to be very small relatively with the velocity of the vessel; and as the resistance increases as the square of the velocity with which the water is moved, it is conceivable enough in what way a sharp bow may diminish the resistance. In the majority of cases, however, the greater part of the power is expended in overcoming the friction of the water upon the bottom of the vessel; and the problem chiefly claiming consideration is, in what way the friction may be diminished. The velocity attained by a large vessel will be greater than that of a small vessel of the same mould and the same proportionate power, in the ratio of the square roots of the linear dimensions of the vessels. A vessel, therefore, with four times the sectional area and four times the power of a smaller symmetrical vessel, and, consequently, of twice the length, will have its speed increased in the proportion of the square root of 1 to the square root of 2, or 1·4 times; and, at the same time, its capacity for carrying will be increased in the proportion of the cubes of the linear dimensions, or eight fold.

"In the case of ocean vessels it is found that paddle vessels fitted with the ordinary radial wheels, and screw vessels fitted with the ordinary screw, are about equally efficient in calms, and in fair or beam-winds, with light and medium immersions. If the vessels are loaded deeply, however—as vessels starting on a long voyage and carrying much coal must almost necessarily be—then the screw has an advantage, since the screw acts in its best manner when deeply immersed, and the paddles in their worst. When a screw and paddle vessel, of the same model and power, are set to encounter head-winds, the paddle vessel, it is found, has in all cases an advantage—not in speed, but in economy of fuel. For, whereas in a paddle vessel, when her progress is resisted, the speed of the engine diminishes nearly in the proportion of the diminished speed of the ship, it happens that in a screw vessel this is not so,—at least, to an equal extent; but the engines work with nearly the same rate of speed as if no increase of resistance had been encountered by the ship. It follows from this circumstance that whereas in paddle-vessels the consumption of steam, and, therefore, of fuel, per hour is materially diminished when head-winds occur;—in screw vessels a similar diminution in the consumption of steam and fuel does not take place.

"In the case of vessels performing distant ocean voyages, in which they may reckon upon the aid of uniform and constant winds, such as the trade-winds or the monsoon, sailing ships of large size will be able to carry more cheaply than any other species of vessel. But where the winds are irregular and there is not much sea-room, or for such circumstances as exist in the Channel or Mediterranean trades, screw vessels with auxiliary power will constitute the cheapest instrument of conveyance.

"612. *Q.*—Are there any facts recorded illustrative of the accuracy of this conclusion?

"*A.*—A full paddle vessel of 1,000 tons burthen, and 350 H.P., will carry about 400 tons of cargo, besides coal for a voyage of 500 miles, and the expense of such a voyage, including wear and tear, depreciation, &c., will be about £190. The duration of the voyage will be about 45½ hours. A screw vessel of 400 tons burthen, and 100 H.P., will carry the same amount of cargo, besides her coals, on the same voyage, and the expense of the voyage, including wear and tear, depreciation, &c., will not be much more than £60. An auxiliary screw vessel, therefore, can carry merchandise at one-third of the cost of a full-powered paddle vessel. By similar comparisons made between the expense of conveying merchandise in auxiliary screw steamers and sailing ships on coasting voyages, it appears that the cost in the screw steamers is about one-third less than in the sailing ships; the greater expedition of the screw steamers much more than compensating for the expense which the maintenance of the machinery involves."

When it is desirable to increase the speed of a paddle vessel, it may be effected by a supplementary screw. In the combination there will be less slip, both upon the paddles and the screw, than if either were employed alone; but in new vessels the same object is attained by giving the vessel larger paddles or a larger screw. The establishment of a system of registration in steam vessels, similar to that which has been so conducive to economy in Cornwall, is only necessary to insure a large and rapid economy of fuel. Mr. Bourne proposes to publish the performances of steam-engines of every class, whether at sea or on land, with the view of determining the consumption of fuel relatively with the power exerted, and invites from engineers, for that purpose, accounts of any engines or other machinery with which they may be familiar. In the case of the Cornish engines, a saving of more than half the fuel was effected by the adoption of the simple expedient of registration. The same principle has occasioned a similar economy in agricultural engines; yet, in both these cases, the benefits are much less eminent than they would be in steam navigation; and it is to be hoped that this expedient of improvement will be speedily adopted.

The tenth and eleventh chapters furnish examples of various forms and applications of engines of recent construction, with specifications of the details and dimensions, and reliable records of performances:—

"697. *Q.*—What is the power necessary to work a sugar mill such as is used to press the juice from canes in the West Indies?

"*A.*—20 H.P. will work a sugar mill having rollers about 5 feet long and 28 inches diameter, the rollers making 2⅓ turns in a minute. If the rollers be 26 inches diameter and 4½ feet long, 18 H.P. will suffice to work them at the same speed, and 16 H.P. if the length be reduced to 3 feet 8 inches. 12 H.P. will be required to work a sugar mill with rollers 24 inches diameter and 4 feet 2 inches long; and 10 H.P. will suffice if the rollers be 3 feet 10 inches long and 23 inches diameter. The speed of the surface of sugar mill rollers should not be greater than 16 feet per minute, to allow time for the canes to part with their juice. In the old mills the speed was invariably too great. The quantity of juice expressed will not be increased by increasing the speed of the rollers, but more of the juice will pass away in the begass or woody refuse of the cane.

"698. *Q.*—What is the amount of power necessary to drive cotton mills?

"*A.*—An indicator or actual horse-power will drive 305 hand mule spindles, with proportion of preparing machinery for the same; or 230 self-acting mule spindles with preparation; or 104 throstle spindles with preparation; or 10½ power looms with common sizing. The throstles referred to are the common throstles spinning 34's twist for power-loom weaving, and the spindles make 4,000 turns per minute. The self-acting mules are Roberts's, about one half spinning 36's weft, and spindles revolving 4,800 turns per minute; and the other half spinning 36's twist, with the spindles revolving 5,200 times per minute. Half the hand mules were spinning 36's weft, at 4,700 revolutions, and the other half 36's twist, at 5,000 revolutions per minute. The average breadth of the looms was 37 inches, weaving 37 inch cloth, making 123 picks per minute,—all common calicoes about 60 reed, Stockport count, and 68 picks to the inch. To take another example in the case of a mill for twisting cotton yarn into thread:—In this mill there are 27 frames with 96 common throstle spindles in each, making in all 2,592 spindles. The spindles turn 2,200 times in a minute; the bobbins are 1⅜ inches diameter, and the part which holds the thread is 2$\frac{3}{16}$ inches long. In addition to the twisting frames the steam-engine works 4 turning lathes, 3 polishing lathes, 2 American machines for turning small bobbins, 2 circular saws—one of 22 and the other of 14 inches diameter, and 24 bobbin heads or machines for filling the bobbins with finished thread. The power required to drive the whole of this machinery is 28½ horses. When all the machinery except the spindles is thrown off, the power required is 21 horses, so that 2,592, the total number of spindles, divided by 21, the total power, is the number of twisting spindles worked by each actual horse-power. The number is 122·84.

"699. *Q.*—What work will be done by a given engine in sawing timber, pressing cotton, blowing furnaces, driving piles, and dredging earth out of rivers?

"*A.*—A high-pressure cylinder, 10 inches diameter, 4 feet stroke, making 35 revolutions, with steam of 90 to 100 lb. on the square inch, supplied by three cylindrical boilers 30 inches diameter and 20 feet long, works two vertical saws of 34 inches stroke, which are capable of cutting 30 feet of yellow pine, 18 inches deep, in the minute. A high-pressure cylinder 14 inches diameter and 4 feet stroke, making 60 strokes per minute, with steam of 40 lb. on the square inch, supplied by three cylindrical boilers without flues, 30 inches diameter and 26 feet long, with 32 square feet of grate surface, works four cotton presses geared 6 to 1, with two screws in each of 7½ inches diameter and 1⅝ pitch, which presses will screw 1,000 bales of cotton in the twelve hours. Also, one high-pressure cylinder of 10 inches diameter and 3 feet stroke, making 45 to 60 revolutions per minute, with steam of 45 to 50 lb. per square inch, with two hydraulic presses having 12 inch rams of 4½ ft. stroke, and force pumps 2 inches diameter and 6 inches stroke, presses 30 bales of cotton per hour. One condensing-engine with cylinder 56 inches diameter, 10 feet stroke, and making 15 strokes per minute, with steam of 60 lb. pressure per square inch, cut off at 1-4th of the stroke, supplied by six boilers, each 5 feet diameter and 24 feet long, with a 22 inch double return flue in each, and 198 square feet of fire-grate, works a blast cylinder of 126 inches diameter, and 10 feet stroke, at 15 strokes per minute. The pressure of the blast is 4 to 5 lb. per square inch; the area of pipes 2,300 square inches, and the engine blows four furnaces of 14 feet diameter, each making 100 tons of pig iron per week. Two high-pressure cylinders, each of 6 inches diameter and 18 inches stroke, making 60 to 80 strokes per minute, with steam of 60 lb. per square inch, lift two rams, each weighing 1,000 lb., five times in a minute, the leaders for the lift being 24 feet long. One high-pressure cylinder of 12 inches diameter and 5 feet stroke, making 20 strokes per minute, with steam of 60 to 70 lb. pressure per square inch, lifts 6 buckets full of dredging per minute from a depth of 30 feet below the water, or lifts 10 buckets full of mud per minute from a depth of 18 feet below the water."

The last chapter furnishes a large amount of practical information on the manufacture and management of steam-engines, of that peculiar character which is generally attained by personal experience alone, and which, when acquired, is usually guarded with professional jealousy.

In recording our opinion of the "Catechism of the Steam-Engine," and quoting largely from its pages, without entering into any discussion of the many points of interest which have arisen during its perusal, we have failed in the object proposed if we have not conveyed our belief that those who peruse it attentively will obtain a more rapid and more practical acquaintance with the steam-engine and its various applications, than they would be likely to acquire from any other source. It embodies the results of the most recent scientific research and practical experience, and is published at a price which places it within the reach of every apprentice.

Annual of Scientific Discovery for 1856; *or, Year-Book of Facts in Science and Art.* Edited by David A. Wells, A.M. Gould and Lincoln, Bostou, U.S., and Trubner and Co., London.

The American Year-book of scientific and artistic facts, like its English namesake noticed in our last Number, exhibits the most important discoveries and improvements in mechanics, useful arts, natural philosophy, chemistry, and astronomy, condensed into a popular shape, and although not always sufficiently explicit to be of practical utility, it serves a useful purpose as a record for reference. The annual meeting of the American Association for the Promotion of Science for the present year, will be important and interesting. Many European *savans* have been invited, and Liebig, of Germany, and Airey, our own Astronomer Royal, have signified their intention of attending. Matters of scientific interest have not been neglected by Russia, notwithstanding the terrible war in which she has been engaged. Six large and thoroughly equipped geographical expeditions have left St. Petersburg during the past season. A chronometric expedition has also been made for determining the longitude between Moscow and Astracan; and the great measurement of the meridian arc, which has been carried from Finland southward, is still going on at the latitude of 45°. The corresponding geodetic observations in Southern Russia are being vigorously prosecuted under the superintendence of General Wroutchekow.

Notwithstanding the paper war fuss with the United States, a valuable donation to the Public Library of Boston has been made by the Commissioners of Patents, of a complete set of publications relative to patents, amounting to nearly 200 volumes; and the Admiralty, in the new map of the Arctic Regions, has adopted the names of the American expedition sent out by Henry Grinnell, Esq., and in particular "Grinnell's Land," which was discovered by that expedition, and had been entered on a previous map as Prince Albert's Land. Gold medals have been presented to the officers and crew of the Franklin relief expedition. The United States Government has sent to the Board of Trade, for gratuitous distribution, a large number of Maury's Sailing Directions and Charts.

The United States musket has been altered to a three-grooved rifle, with barrel 40 in. long and 0·58 in. in diameter, and weighing, complete with bayonet and mountings, 9⅝ lb. The ball is hollow, elongated, and pointed, and weighs 497 grains.

It has been found economical on the Erie Railroad to renovate the cotton waste after it has been used, by treatment with steam and pressing. The St. Louis Association of Steamboat Engineers have examined the subject of fusible safety-plugs for steam-boilers, and arrived at the conclusion that they are useless to the engineer and no protection to the travelling public.

LIST OF NEW BOOKS OR NEW EDITIONS OF BOOKS.

BARLOW'S TABLES of Squares, Cubes, Square Roots, Cube Roots, Reciprocals of all Integer Numbers up to 10,000. New edition, crown 8vo, pp. 208, cloth, 8s. (Walton.)

BOURNE (J.)—A Catechism of the Steam-Engine in its various Application to Mines, Mills, Steam Navigation, Railways, and Agriculture, with Practical Instructions for the Management of engines of every class. By John Bourne. 4th edition, enlarged and improved, 12mo, pp. 562, cloth, 6s. (Longman.)

NESBIT (J. C.)—On Agricultural Chemistry, and the Nature and Properties of Peruvian Guano. By J. C. Nesbit. 3rd edition, 8vo, pp. 128, cloth, 4s. (Longman.)

ATKINSON (T.)—Elementary Treatise on Arithmetic. By Thomas Atkinson. 12mo, 3s. (Scott.)

BURN (R. S.)—The Illustrated Architectural, Engineering, and Mechanical Drawing-Book, for the use of Schools, Students, and Artizans. By Robert Scott Burn. 2nd edition, revised, 8vo, pp. 144, cloth, 2s. (Ward and Lock.)

WEIGALL (C. H.)—Projection of Shadows: Sequel to "Manual of Perspective." By C. H. Weigall. Post 8vo, 1s. (Reeves.)

AMERICAN BOOKS.

BYRNE (O.)—Pocket-Book for Railroad and Civil Engineers, containing New, Exact, and Concise Methods for Laying out Railroad Curves, Switches, Frog Angles, and Crossings; the Staking out of Work; Levelling; the Calculation of Cuttings and Embankments, Earthworks, &c. By Oliver Byrne. 12mo (New York), pp. 163, roan tuck, London, 7s. 6d.

REPORT of the Commissioners of Patents for 1854. Arts and Manufactures. 2 vols. Vol. 1.—Text, pp. 784. Vol. 2.—Illustrations, pp. 364, 8vo (Washington), cloth, London, 13s.

SILLIMAN.—Journal of Science and Arts, conducted by Professors B. Silliman, B. Silliman, jun., and James D. Dana, &c. Published every second month. 8vo (March), sewed, London, 5s.

WELLS (D. A.)—Familiar Science, or the Scientific Explanation of the Principles of Natural and Physical Science, and their Practical and Familiar Applications to the Employments and Necessities of Common Life; with upwards of 100 illustrations. By David A. Wells, A.M. 8vo (Philadelphia), pp. 566, half-bound, London, 9s.

SOCIETY OF ARTS.

EIGHTH ANNUAL EXHIBITION OF RECENT INVENTIONS.

This exhibition was opened to the public on the 24th March, and is worthy of a visit. Notwithstanding, we were disappointed in again finding that the efforts of the Council of the Society have not been fully supported by the inventors of this country as a class, for the comparatively few novel inventions exhibited this year reflects greatly to their discredit, as such an exhibition annually, if properly contributed to, would prove of great advantage to the artizan and scientific student, whilst, from the publicity thus given to inventions of merit, inventors might reasonably anticipate pecuniary advantages.

The number of models, specimens, plans, &c., exhibited, is stated in the Catalogue to be 223. These have been classified under six divisions. Many of the inventions are not, strictly speaking, new, and some of the things exhibited are unworthy of a place.

In the 1st class—viz., Motive Machines, including Railway Mechanism—there are several smoke-consuming or smoke-preventing schemes. We noticed, also, W. K. Hall's Safety Apparatus for Steam Boilers, as described in The Artizan for April; Barrans' Cup-surfaced Steam Boilers in several forms, and applied to various purposes; J. D. Humphreys' Expansive Steam-Engine, which may answer the expectations of the inventor if he can succeed in introducing boilers to work at a considerably higher pressure than is at present ordinarily employed. We were called upon, some months ago, to inspect a small engine, constructed upon this principle, at the premises of Mr. Franklinski; but the thing was a sad botch and a disgrace to the maker, and in every way unsuitable for testing fairly the alleged advantages, to be derived from the use of a large and a small trunk engine connected together upon the same crank-shaft, the steam acting first upon the annular surface of the small piston, then below it, next passing to the larger cylinder, where it first acts upon the annular surface of the piston and then upon the whole under surface; thus, the same steam is used four times, being expanded three times after it enters the first cylinder.

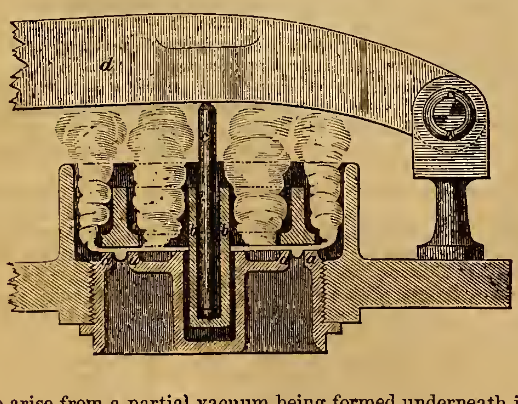
The next of the improved steam-engine genus is the Combined Trunk Double Expansion Marine Engine, by E. E. Allen. This has been fully described in The Artizan, and is the result of considerable application to the subject of marine engine economy by the inventor, and deserves attention. Great economy in space and weight of engine, saving of fuel, and dispensing with expansion gear are the advantages claimed. Mr. Allen's elaborate paper upon this subject, read before the Institution of Mechanical Engineers, at Birmingham, where it was also fully discussed, leaves nothing else to be said with reference to it, except that we hope Mr. Allen will have the opportunity of putting his theories into practice, and that we may have the benefit of the practical experience from the results thus acquired.

The Parallel-action Z-crank Engine, for marine propulsion, by Morton and Hunt, is a curious and ingenious contrivance for driving screw-propellers direct, and is described by the inventors as follows :—

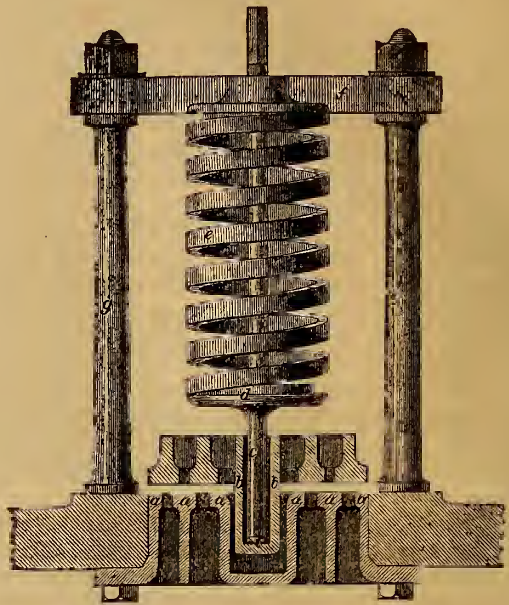
" In these engines the cylinders are placed with their axes parallel to the propeller shaft, and their pistons work out longitudinally as regards the vessel. The cylinders are at the same time placed as close as is convenient to the shaft, and the additional space taken up by the details which communicate the motion to the latter, is scarcely more than equal to the length of the piston's stroke. The chief peculiarity of the arrangement is the form of the shaft, which has two cranks forged upon it, nearly at right angles to its axis, whilst the elongated journal, which lies between and connects them, is inclined to, and crosses the axis of the shaft, in such a manner that the cranks stand out from diametrically opposite points of the shaft, the whole being termed a Z-crank, from its zigzag form. Upon the inclined cross-piece of the Z-crank is placed a lever-piece, consisting of an elongated tubular boss, having four arms standing out at right angles to the cross-piece and to each other. The two upper and longer arms are jointed to the connecting-rods of the two steam cylinders, whilst the lower and shorter arms are similarly jointed to the connecting-rods of the air-pumps. The combined action of the pistons on the Z-crank causes the shaft to rotate, one piston being at the most effective part of its stroke while the other is on the dead centre, as in common engines, where two steam pistons are connected to cranks at right angles to each other. The rotation of the Z-crank causes the ends of the lever-piece arms to reciprocate longitudinally as regards the shaft, and the lower arms consequently work the air-pump pistons in and out. As these arms are scarcely more than half the length of the upper arms, the stroke of the air-pump piston is considerably less than that of the steam pistons, so that the speed at which the air-pumps are worked is comparatively low, the advantage of which is well understood. Whilst the compactness of these engines is incontestible, this quality is not accompanied by any complexity of parts or other defect. There is no part about the engines requiring attention, or at all likely to need repairs which cannot be got at with the greatest facility. The shaft is self-balanced, owing to the peculiar form of the crank, and can, consequently, be driven at a higher speed than common engines, in which the heavy unbalanced cranks makes the motion irregular, and, in fact, the whole arrangement of the engines is such as to reduce the vibration of the moving parts to a minimum."

There are several contrivances for Safety-valves, some of which have been already described in The Artizan.

Patent Annular Safety-Valve, by W. Hawthorn.—" In practice the common mitre safety-valves for steam boilers are found to lift to a very small extent for the escape of the steam, when the pressure in the boiler exceeds the load upon the valve. If the latter be continued uniform, and the pressure of steam increased, the lift of the valve-lid is not in accordance with the increase of pressure, and is in no case proportionate to the full area of the valve. This defective lifting of the valve-lid is



found to arise from a partial vacuum being formed underneath it, by the radiating discharge of the steam forming an inverted cone, the interior of which is kept in a state of exhaustion by the rapid diverging streamlets as they issue from the circumference of the lid as soon as it is lifted from the valve face. The annular valve has been designed with the view of counteracting this defect. The centre part of the lid is removed and cast in one piece with the valve seat, so that as soon as the valve-lid is lifted the steam can escape through the central part of it as well as past its external circumference, thus giving nearly double the amount of escape for the steam with the same lift as a common mitre safety-valve of similar external diameter, and by using a greater number of rings with the same lift, the escapement may be increased to any required amount. These valves also possess the further advantage of requiring much less weight to load them to resist a given pressure.



The valve faces are either made concave, and the lid of the form of the segment of a sphere, or they are made upon the same plane, so that the expansion of the metal by heat does not affect their bearings; and, by making the spindle or boss of the valve-lid hollow, the valve is loaded by the weight pin below the level of the faces, thus giving to the valve-lid a self-adjusting tendency, and not depending on the boss or pin as a guide, they have a perfectly free action in their sockets, whereby friction is avoided. Fig. 1 is a sectional elevation of an annular safety-valve, with flat faces, *a a*. The spindle or boss, *b*, of the lid is hollow, to allow the weight pin, *c*, to pass down it. The valve is loaded by a lever, *d*, and spring balance, *e*, in the ordinary manner. Fig. 2 represents an elevation of a double annular safety-valve, with flat faces, *a*, *a*, and hollow boss or spindle, *b*; the weight pin, *c*, has a collar, *d*, formed upon it to carry the spiral spring, *e*, which is compressed by the cross-bar, *f*, and two lateral bolts, *g*, *g*, to give the required load direct to the valve-lid."

Gwynne and Co. exhibit an Improved Pressure-Gauge for steam, gas, water, &c.

T. Ricketts exhibits the Patent Equilibrium Pressure-Gauge, described in The Artizan for February last.

A Spring Governor, by W. I. Simons, is a simple contrivance, which can be applied directly to the engine, either vertically, obliquely, or horizontally, thus saving cranks, levers, &c., and is stated to be only one-third the cost of the ordinary governor.

A. P. How exhibits his Improved Counter and Clock for registering the number of revolutions or vibrations made by an engine or machine. The apparatus is as elegant as it is useful and reliable.

There are several pumps. That exhibited by S. Holman has been described in our pages.

In railway matters there are a few ingenious contrivances worthy of note. Hughes' Compensating Wedge for the cylinder of locomotive and other steam engines; E. Lund's Flexible Joint for feed-pipes, which is stated to have been satisfactorily tested on the Lancashire and Yorkshire Railway; the Wrought-iron Fish-chair, by A. S. Jee; and H. Carr's Patent Railway Crossings, are pretty well known to our readers.

W. B. Adams exhibits three of his many ingenious contrivances for improving permanent ways.

Greaves' Surface-packed Sleepers, with fish-joints, &c., are well known.

J. C. Brant, and others, also exhibit permanent way improvements.

Barrans' Patent Railway Axle-box and Bearings, for preventing end play and its consequences. Some very satisfactory illustrations of the advantages of this plan are exhibited; some of the bearings, &c., shown having, it is stated, run nearly 50,000 miles.

G. N. Hooper exhibits various improvements in pleasure carriages; W. C. Fuller's Patent India-rubber Springs for Carriages are exhibited in every variety; HUNT's Universal Safety Hook has been described and illustrated in our pages; it is a kind of slip-shackle. Four improvements in omnibuses are exhibited, and bring up the rear of this array under the first class.

IN CLASS 2—Manufacturing Machines and Tools—we found several inventions which should be exhibited under other classes.

SHARP, STEWART and Co., exhibit a very extensive set of drawings of machine tools, manufactured by them;—they are all admirable tools.

J. FENN exhibits a Portable Machine for Slitting and Polishing Minerals, his improved Ratchet Brace, &c., &c.

R. NEALE exhibits a machine for performing all the functions of the engraved plate printer. "The plate is attached to a bed having a reciprocating motion. The difficulty of printing from engraved plates by machinery has been owing to the inability of substituting for the hand a mode of cleaning and polishing the plate mechanically. In this machine this is effected by a series of wipers and polishers, having a rotary motion, and accurately adjusted, being passed over the surface of the plate in succession, so as first to remove the surplus ink, and then to clean and polish the surface of the plate, ready to receive the paper to be printed. These wipers and polishers are cleaned in their turn by coming in contact with the surfaces of cleaning belts, and are made ready to act again on the plate."

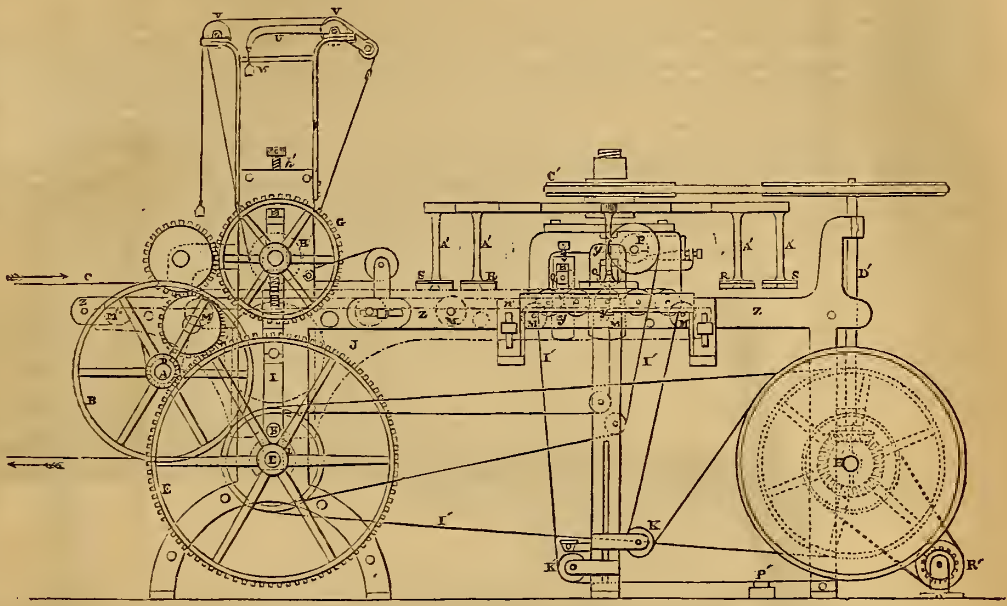
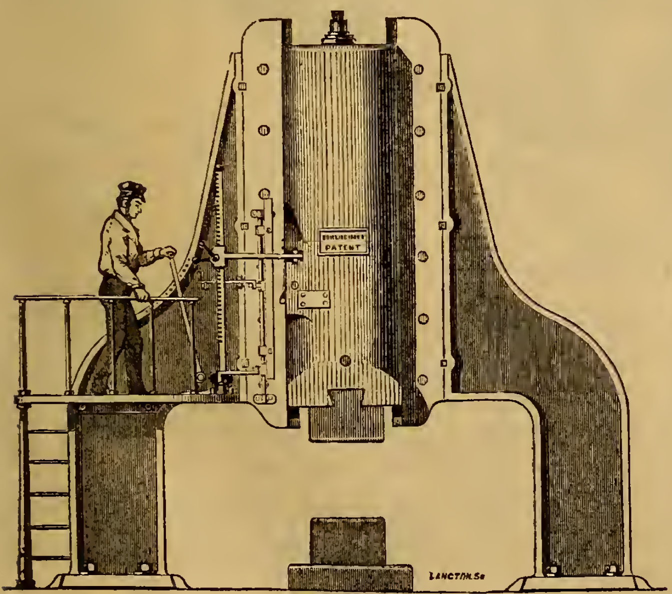


PLATE PRINTING MACHINE, FOR ENGRAVED PLATES.

T. WATERHOUSE exhibits a drawing of a compressed air forge-hammer, suitable for small work. He adds a cylinder above, into which works a piston connected to the hammer, the latter being raised by tappets on the motion-shaft, causes the piston to compress the air within the cylinder, and by the re-action the hammer is thus made to fall with increased force.

A drawing of the BOWLING IRON COMPANY's Patent Steam Hammer is exhibited. The peculiarity therein is that by bolting the steam cylinder on the back of the hammer-block the machine is reduced in height,—can be thoroughly framed together, and permits of a larger and heavier



THE BOWLING IRON COMPANY'S PATENT STEAM HAMMER.

hammer-block being used therein, and with longer and better guiding and wearing surfaces. There are also other improved details by which an excellent steam hammer has been produced, and a 5 ton hammer has been in constant use at the Company's Works for upwards of twelve months, and is giving great satisfaction.

KENDALL and GENT exhibit a very useful instrument for cutting metallic tubes. There are also three contrivances for holding objects in course of manipulation—viz., HENRY's Adjustable Vice, MARCHINTON BROTHERS' Vice for griping tapered objects, and J. BRODIE's Improved Holding Instruments.

IN CLASS 3 we notice a Letter Copying Press, by T. T. LINGARD, the peculiarity being that the screw is horizontal—is right and left handed, having two travelling nuts acting upon the double-inclined bottom of the lower platten, the two nuts approaching cause the platten to rise and compress the book between its surface and the upper plate.

ROBERTSON and Co. exhibit an ingenious and complete Label Damper.

A Patent Dry Gas Regulator, by C. R. MEAD, has the disadvantage of numerous joints, pins, levers, and valves, which, in the course of a few months, are likely to become clogged, and impair the action of a contrivance otherwise serviceable.

G. JENNINGS exhibits in force;—he has nine or a dozen very simple, ingenious, and cheap contrivances for various domestic purposes.

W. L. BAKER, C.E., exhibits models of his improved mode of hanging church and other large bells;—the invention is ingenious, and well worthy of notice and practical adoption, the novelty being in causing the bell to turn a small portion of a revolution each time it is caused to vibrate—thus, the clapper does not strike the same spot twice in succession, by which the damage to bells, from their being constantly struck in the same place, is avoided.

IN CLASS 4, the Globotype Telegraph, by D. MCCALLUM, is exhibited. To this invention we were the first to call public attention. In THE ARTIZAN for March is a very full description, with wood-cuts.

There are various improved Marine Compasses, Ships' Logs, Course-indicators, &c., by W. D. GRAY, MATHIESON, and RITTER, J. BOYD and Capt. E. PÉCOUL.

A model of Russell's Patent Apparatus for Lowering and Disengaging Ships' Boats is exhibited; but we cannot give the preference to this plan after having seen Clifford's very simple and ingenious invention for the same purpose practically tested several times.

In the way of Anchors, ROBERTSON and Co. exhibit two varieties—one by Firmin, styled the Ribbed Anchor, and the other a Framed Anchor by Scott. The peculiarity of the latter being that the stock is formed of two plates, with or without a wooden fillet between them, and the arms and stock are secured by pins, with cross-keys. There are several photographic cameras and other similar apparatus exhibited in this class.

CLASS 5—Agricultural Machinery, &c.—exhibits no novelties of interest to the engineer, machinist, or artizan,—or that are worthy of note.

OF CLASS 6—Miscellaneous—we may almost say the same, except as to the Railway Signal, Carriage-roof, and other Candle-lamps.

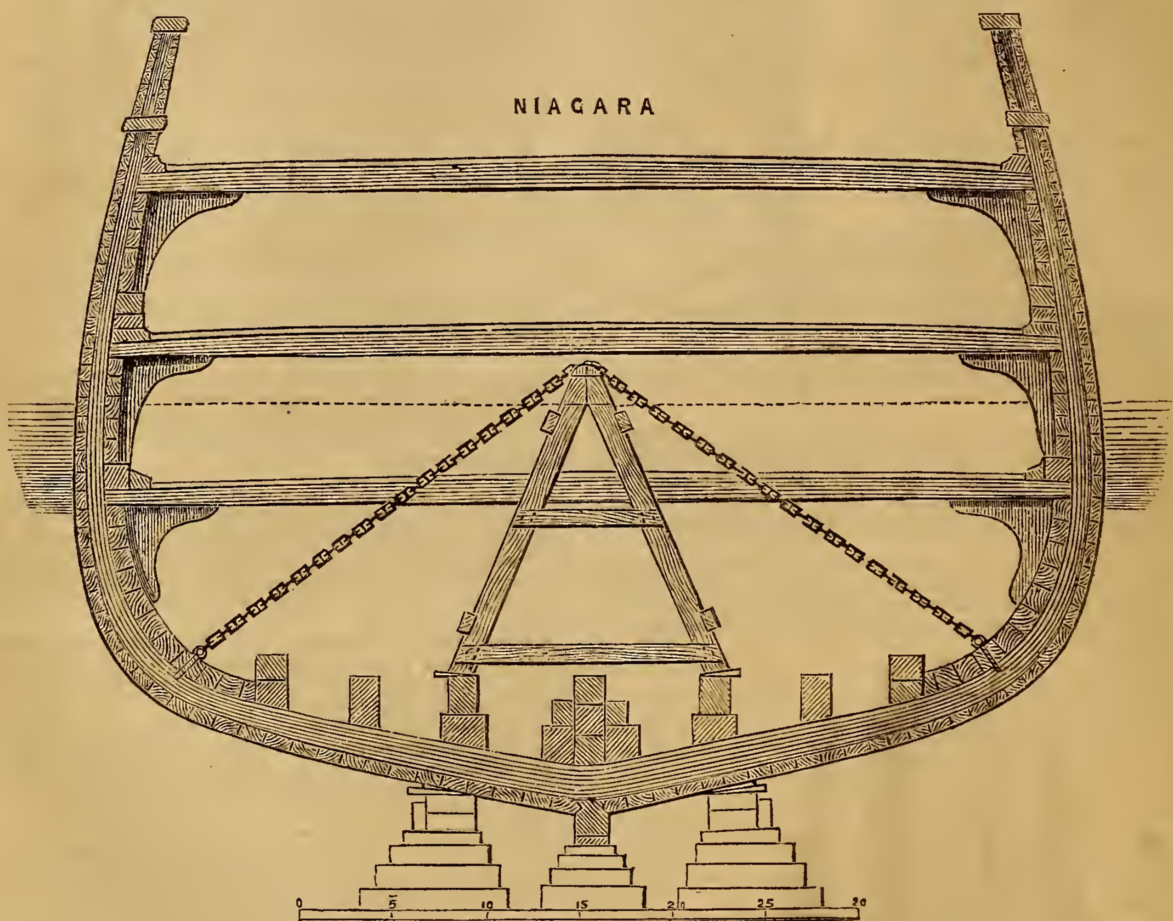
AMERICAN NOTES, 1856.—No. V.

STEAM NAVIGATION.

Launching and Docking of U.S. Steamer "Niagara."—Through the enterprise of the U.S. "Nautical Magazine," and the politeness of its editor, I am enabled to give you a proof print of a sectional drawing of the hull of the steam frigate *Niagara*, as she was fitted for the operation of launching and docking, in order to save her hull from being strained when it was unsupported by shores.

The magazine referred to in treating of this thus writes:—

"The folly of transmitting the weight of the entire fabric to the weakest parts of ships (the bottom and decks), was not committed in the launch of this vessel, as will be seen by reference to the annexed engraving; and, we may add, that this arrangement was quite as essential for docking the vessel in the stone dry-docks of the Government as for launching her. The bottom of the vessel being the weakest part of the outside shell, cannot sustain the weight of the fabric without a disproportionate strain, which causes such transformation of shape as is commonly denominated 'hogging.' Hence, we find that nearly all of our Government vessels are hogged in docking them in the stone dry-docks at Charleston, Brooklyn, and Gosport Navy Yards. The very small amount of vertical support the sides and bilge of the vessel receives from two sets of shores, the one directly horizontal, and the other nearly so, before the bilge is clear of the water, is of little consequence; and no one up to the present time has been able to determine what proportion of this deformity of shape was consequent upon docking the vessel. In other words, no one can make a just appropriation of that



amount of hogging which properly belongs to the dry-dock, and show what amount of deformity belonged properly to the surges and perils of the sea. Inasmuch as it was not the province of the constructor of the *Niagara* to alter the dock, it only remained for him to prepare his vessel against its dangerous tendencies; and this was fully accomplished in the preparation for launching her. Hence, it will be perceived that it was only necessary to put up stanchions between the chain supporters and the keelson, when the sides would at once be required to sustain their due proportion of the strain demanded of the keel, in the same manner in which they relieved the bottom in launching. We are aware that it is assumed, that, if a vessel in dock cannot spread, it follows that she cannot settle. But '*axe and adze carpenters*' know better than this. It is a chimerical notion, and has no foundation in truth or science. Every ship placed in the docks referred to has *less* dead rise when the water is removed than when she was floated into dock, because of her being allowed to bear almost her entire weight on her keel. The keel and bottom of a ship 200 feet long may spring from two to four inches, and the deflection would be hardly noticed; and if it was, it would be charged to *sea, instead of dock service.* Nor can it be otherwise in Government vessels, with a live oak keelson made up of short lengths from 25 to 30 feet."

Engines of Steamer Niagara (designed by Mr. Copeland).—The engines (three in number) are horizontal and direct-acting. Each frame for cylinders is cast in one piece; the cylinders have slide-valves, and a separate cut-off or expansion slide-valve, adjustable so as to cut off at any point from three-eighths to five-eighths of the stroke.

Each cylinder has its own separate condenser, air-pump, and hot-well —in fact, with the exception only of the main shaft, there are three complete engines, so that should either become deranged or disabled, the others will be available.

The air-pumps are 22 in. in diameter, and are worked direct from one piston-rod of the steam cylinder; and the feed-pumps are worked from the other piston-rod. The main shaft, the cranks of which are set at an angle of 120° with each other, is 17 in. diameter, of wrought iron, and the whole length over 100 feet.

The propeller (of composition) is a screw, having an increasing pitch, which, at periphery, is 29½ ft. Propeller, 18 ft. 3 in. diameter, and 4 ft. 2 in. in length. Estimated weight of propeller, 23,600 lb.

The boilers, four in number, are 11½ ft. in length, 21 ft. in width, and 15 ft. in height. They are of the vertical tube variety, and the arrangement patented by Mr. Martin, the Engineer-in-chief, U. S. Navy. They are very compact and well-arranged, and will probably prove as efficient and economical as any boilers of this description. They will be set in pairs, the flues discharging into two chimneys, the one forward of the other.

The contractors for the machinery of the *Niagara* are Messrs. Pease and Murphy, and the execution of the whole is such as to reflect great

ENGINES OF U. S. STEAM FRIGATE, "NIAGARA."
Built by Pease and Murphy, New York, 1855-56.

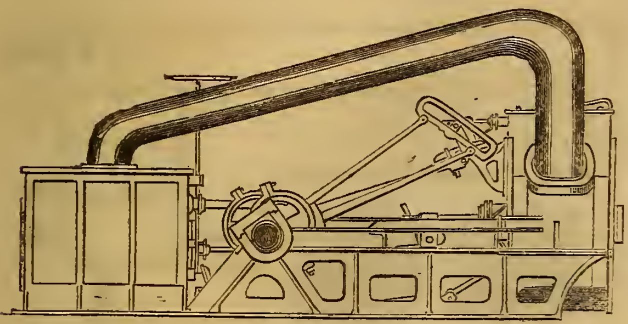


Fig. 1.

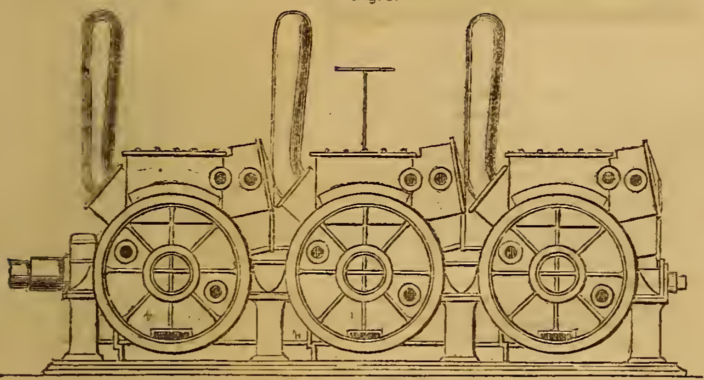


Fig. 2.

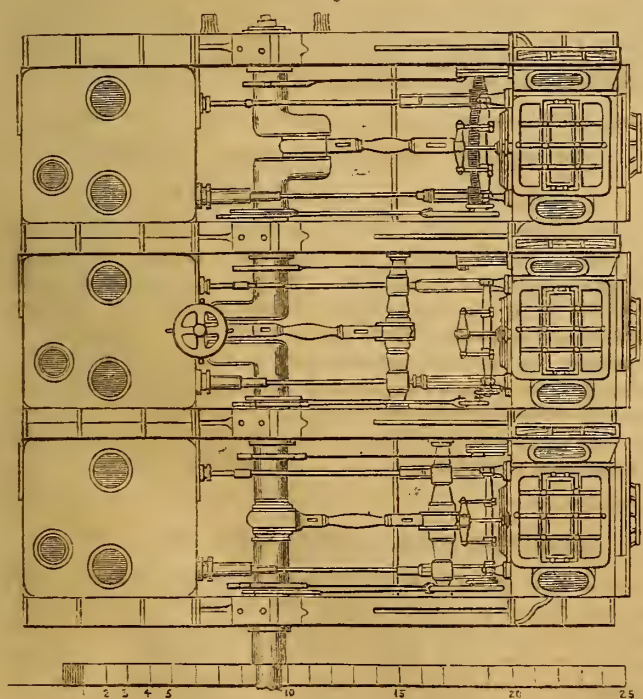


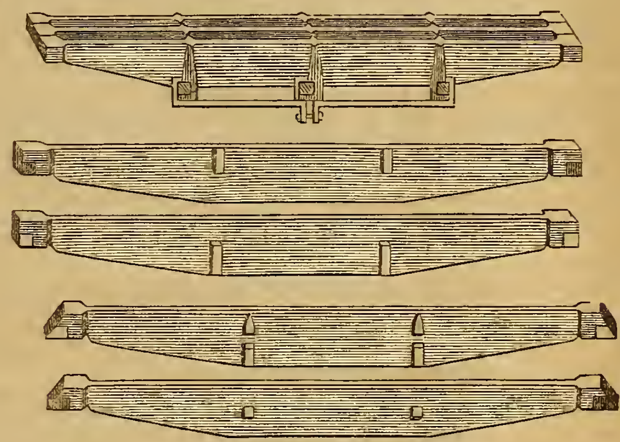
Fig. 3.

credit upon them, and exhibits a determination that they shall fairly claim a full share of the reputation which we have no doubt will be awarded to all concerned in the construction of this fine ship, when fully tested.

As an evidence of the extent to which simplicity has been carried on in these engines, each cylinder has its steam-chest, expansion steam-chest, and one of the cylinder-heads all cast in one piece. Also the condenser of each engine, with its hot-well, air-pump, and feed-pump, are cast in one piece. This, of course, produces very complex castings; but, notwithstanding their complexity, there has scarcely a blemish been discovered in any of them. In fact, the contractors are evidently desirous that the whole should prove strong, serviceable, and efficient.—*U. S. Nautical Magazine.*

Salamander Grate Bars.—This is a name given to a new construction of grate bar, invented here by Mr. Samuel Van Sychel. Sketches of the three modes of constructing them are given in the cuts. The Company who hold the right to make and vend them here have addressed the following card :—

"One of the greatest annoyances to which manufacturers and those using steam are subjected, is the rapid destruction of their grate bars, and the absolute necessity of replacing them. It is well known by those experienced in the use of furnaces, that the ordinary bars, commonly employed, cannot be used long before they begin to warp and twist out of place, whereby the draught is greatly obstructed, and much fuel lost. This, of course, is not only very expensive, but is a great hindrance, and every attempt has been made to obviate this difficulty, but hitherto without success.



"The Salamander Patent Grate Bars have been fully tested and found to effect the long-wanted desideratum. The attention of manufacturers, locomotive makers, steamboat owners, &c., is requested to this improvement, by which a set of bars may be so secured in a furnace that they will not warp in the least, or spring out of shape, and last many years longer than the bars ordinarily used. A single examination will satisfy any one of their economy and durability, and that the improvement is of great value."

Now this alone might fail to arrest the attention of steamboat or steam-engine owners, but it so occurs that it is accompanied with the address of ninety different parties, who have adopted this bar and recommend its use to others. It has been patented in England and France, and as the proprietors of the patents are submitting them to the attention of your countrymen, this notice will serve to introduce the subject to them.

Watertight Compartments in Steamers.—The loss of the *Arctic*, the injury received by the *Persia*, and the non-arrival of the *Pacific*, have awakened the attention of both the underwriters and steamer owners to the propriety of all sea steamers being fitted with athwartship bulkheads, so as to afford watertight compartments.

The *Baltic*, of the Collins' Line, has just been fitted in this manner. The manner of their construction was as follows :—

The bottom, up to a line with the keelson, is filled in with oak plank, watertight; a stanchion is run up to the deck above, and a section of kiln-dried yellow pine plank, two inches thick, tongued and grooved together, and firmly fastened to the sides of the vessel, is then put up. Upon this is placed a coat of white turpentine, covered with a thick blanket. Another section of yellow pine plank is built over this, the planks running transversely to those of the first section, and the whole is rivetted together with iron bolts. The Messrs. Steers have already fitted up the *Atlantic* (while in the water) with bulkheads similarly constructed. The *Adriatic* will be furnished after launching. It was the intention of the owners to fit the *Pacific* up, on her return from this trip, as thoroughly as her consorts have been.

MISCELLANEOUS.

Sibley's Emery Sticks.—So successful has this essay of Mr. Sibley proved, that these sticks, and an emery cloth also, are being manufactured by a company under his directions, and it is unable to meet the demand for the consumption in the State of Massachusetts alone, where it is in operation, much less that of the United States at large. Increased facilities, however, are in rapid progress of completion; and Mr. Charles H. Haswell, of New York, has been appointed the agent for the sale of these articles for the Middle, Southern, and Western States.

U.S. Steam Frigate "Niagara."—So much has been said and written about this vessel upon this side of the ocean, that it is but fair, in a point of reciprocity, that I should give your domestic readers a reflection of some of the views regarding her.

In a previous Number I referred to the fact that her builder (George Steers) had, in order to reduce the draught of water as much as practicable, and, at the same time, to decrease her immersed section; or, in other words, under the impulse of talent, he sought to attain the greatest results with the least means, and instead of falling back upon the stereotyped customs regarding scantling, materials, dimensions, and in fastenings, he has used lighter materials than usual and securer fastenings. So widely has his practice differed from that of precedents in naval constructions that it was confidently predicted that it would be impracticable for this vessel to retain her shape after being launched, sufficiently near to the requirements of the case to make her sea-worthy. The result has signally disproved the error of the prediction, for I am advised, by one whom I consider reliable authority, that he has sighted her both on the stocks and since launching, and that her alteration, from a horizontal line, is just under one inch. In a vessel of this length this rigidity of structure is all that is required, if it is not unprecedented.

Silver's Marine Engine Governor.—This instrument since it has been so successfully tried upon the Collins' line steamer *Atlantic* for several trips, is attracting considerable attention, as it is the first successful application of a governor to marine engines. It is reported here that Mr. Brunel, who has the superintendence of the construction in England of the mammoth steamer, has determined to apply them to her engines. The Novelty Works first introduced it in the *Atlantic*, and has them prepared for the other steamers of that line, including the *Adriatic*, now building.

New York Yacht Club.—This Club, at its late annual meeting, appointed a committee of three members—viz., L. M. Rutherford, Charles H. Haswell, and James M. Waterbury—to consider the present system of classification of yachts, with a view to the introduction of a change therein, if one was thought to be expedient.

This committee, having had several meetings, have decided to submit to the Club, at a meeting especially called for the purpose, and recommend for its adoption the classification of all yachts upon the novel basis of the areas of their canvas. If this recommendation is approved of, and it meets with universal favour in the discussions of the members of the Club, proper means will be taken by the committee to arrive at a just allowance of time for differences of canvas.

Your yachting readers cannot fail to acquiesce in the propriety of the change, for with the existing system, based upon displacement alone, stability is the essential element for winning cups: for with much wind a greater proportion of canvas can be carried, and with light winds a greater amount of canvas can be spread. With canvas as the basis of comparative powers, builders must fall back upon their models as a whole for success, and not upon one element, to be obtained at the sacrifice of others.

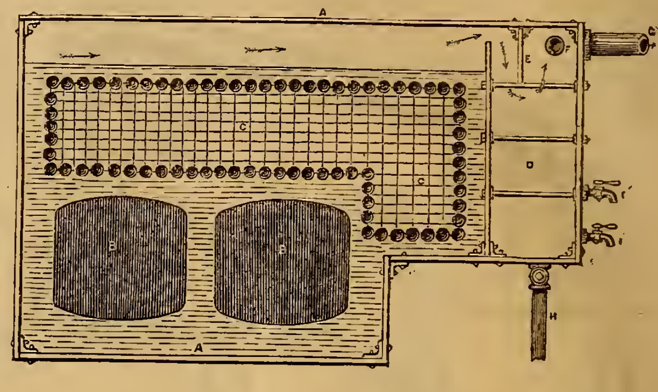
H.

RENNIE'S IMPROVEMENT IN MARINE BOILERS.

In the specification of this patent Mr. Rennie states that, inasmuch as when marine boilers are required to be of the least possible height, so as to be kept below a certain level in the vessel, as for example, below the load water-line, they are frequently or commonly liable to prime or discharge the water contained within them along with the steam into the steam-engine cylinders, and thereby cause damage to and impede the perfect working of the engines. And as it is a desideratum in all steam-engine boilers, but in marine boilers more particularly, that steam be delivered to an engine in as dry or free a state as possible, that is, not surcharged with water, the following arrangement has been designed, by which boilers can be constructed so low as to enable them to be fixed in all ordinary cases below the water-line of a vessel, at the same time obviating the surcharging of the steam with water, "or priming over," and so insure the steam being delivered to the engine in a suitable state. This is effected in the following manner:—

To the boiler is added a chamber, which may either be an extension thereof, or may be a distinct vessel of suitable strength and size, having an opening or passage to the boiler as high up in the steam space as convenient; but such opening or passage must not be of a less area than the bore of the pipe for the supply of steam to the engine or engines.

This steam chamber need not be subjected to the direct action of the fire, but it must be maintained at a sufficient high temperature so as not to impair the elastic force of the steam, or allow of its condensing within the vessel or chamber. The steam-pipe must be inserted in the most convenient position in or near to the top of this steam chamber.



RENNIE'S MARINE BOILERS.

In the bottom of this chamber there should be inserted a pipe, with a blow-off cock, so as at any time to free it from the presence of water, which might be carried over along with the steam; and in the accompanying drawing gauge-cocks are shown, by which the height of condensed water can be readily ascertained.

The accompanying drawing is a longitudinal section of this invention, as applied to a low boiler for a vessel of shallow draught, in which the furnaces are placed athwart ship, instead of fore and aft.

A A is the shell of the boiler; B B, the furnaces; C C, the tubes; D is the chamber.

Instead of permitting the steam to be drawn direct from off the surface of the water into the steam-pipe in such a boiler, a screw-plate, E, is interposed between the opening from the boiler, or more than one of such plates may be inserted.

In the drawing hereunto annexed the chamber D is shown as a continuation of the boiler, A, because the peculiarities of the construction and position of that boiler permits of its being so applied most advantageously; but the Patentee does not confine himself to the precise arrangement shown in the accompanying drawing, as similar drying chambers may be added to marine boilers either at the side or end.

THE SCREW STEAM TRANSPORT "EMEU."

Hull and Machinery by Messrs. R. Napier and Sons.

In our Number for April, 1854, will be found a Plate of the lines of this vessel. In this Number is a longitudinal section (Plate lxix), showing all the interior arrangements. We have no hesitation in saying that this is by far the most complete Plate of the kind that has been published, and we have no doubt will be useful to and appreciated by our readers. Of the vessel and machinery we need say nothing, as full particulars have already been given in The Artizan, and the present plate is so explanatory that any description here would be superfluous. The *Emeu* has been for some time in the service of the Government, for the conveyance of troops, stores, &c., to and from the Crimea.

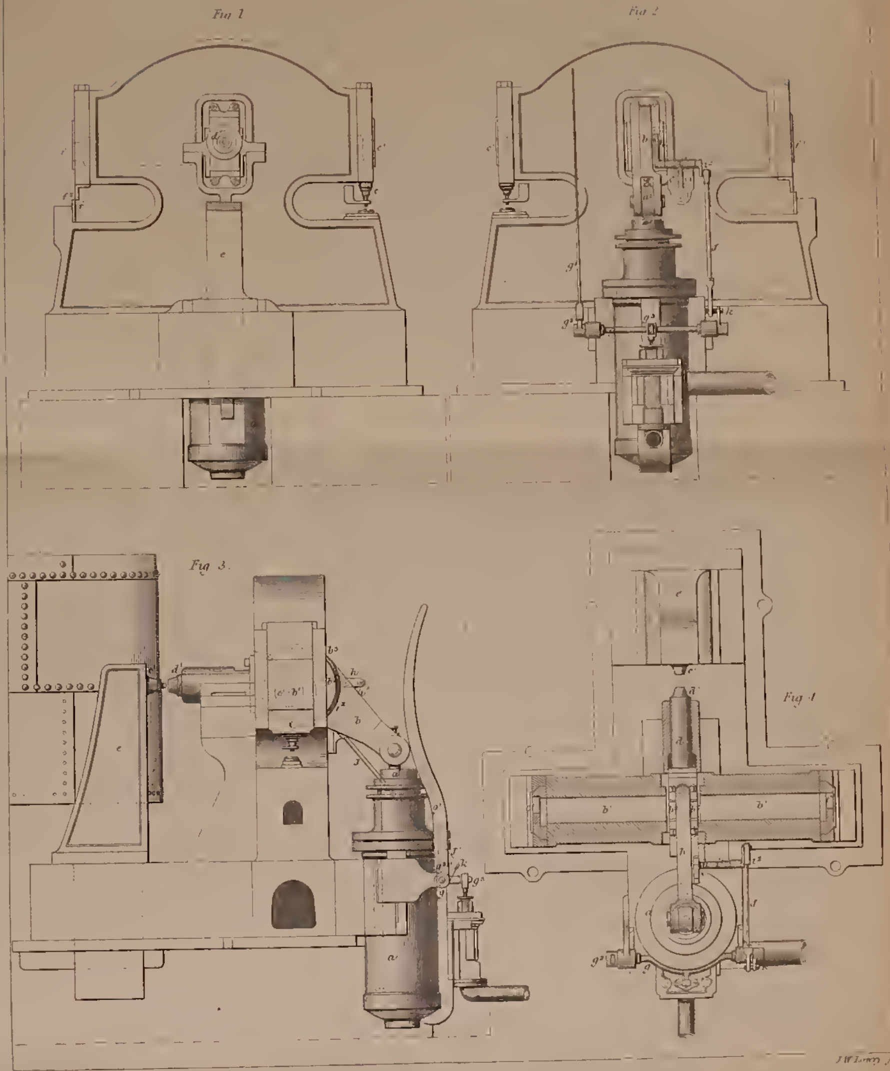
IMPROVED SMOKE-CONSUMING FURNACE.

This is the invention of M. Sebile, Engineer, of Nantes, France, communicated to, and patented in this country by, Mr. W Smith, C.E., of Salisbury Street, Adelphi. The accompanying wood-cuts convey to our readers an accurate idea of the construction of this plan of a Smoke-consuming, or, more properly, Smoke-preventing Furnace; but the following short description, having relation to Figs. 1, 2, and 3, will, it is thought, make the invention thoroughly understood.

This invention consists in the arrangement of a double set of furnace-bars mounted in a horizontal frame, which turns upon a vertical axis, and

PLATE LXXV

COOK'S PATENT RIVETTING, PUNCHING & SHEARING MACHINE.



W. Smith, C.E. drawn

J. W. Lowry sc.

NEW

WILLI

Fig. 4. *General Elevation.*

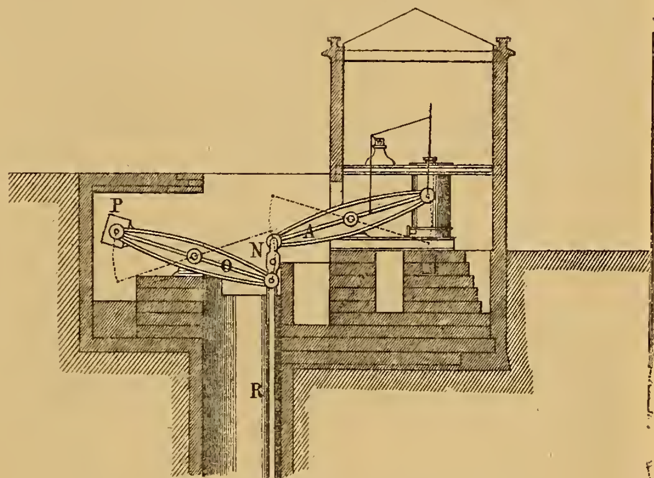
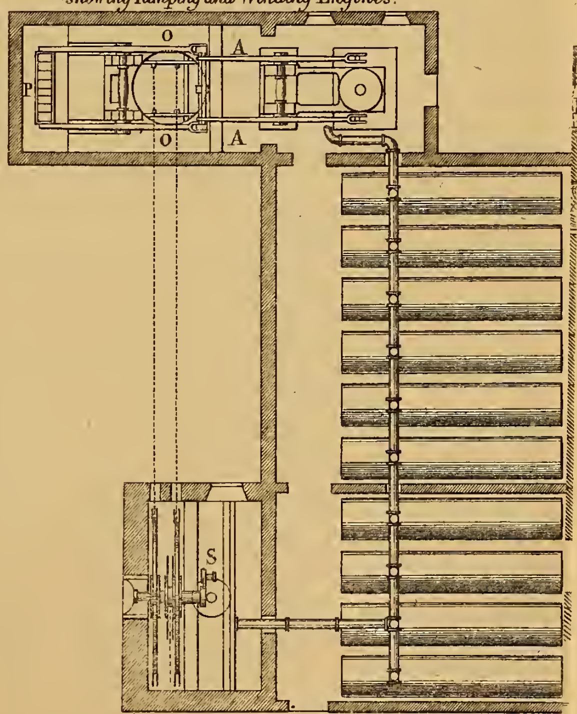


Fig. 5. *General Plan showing Pumping and Winding Engines.*

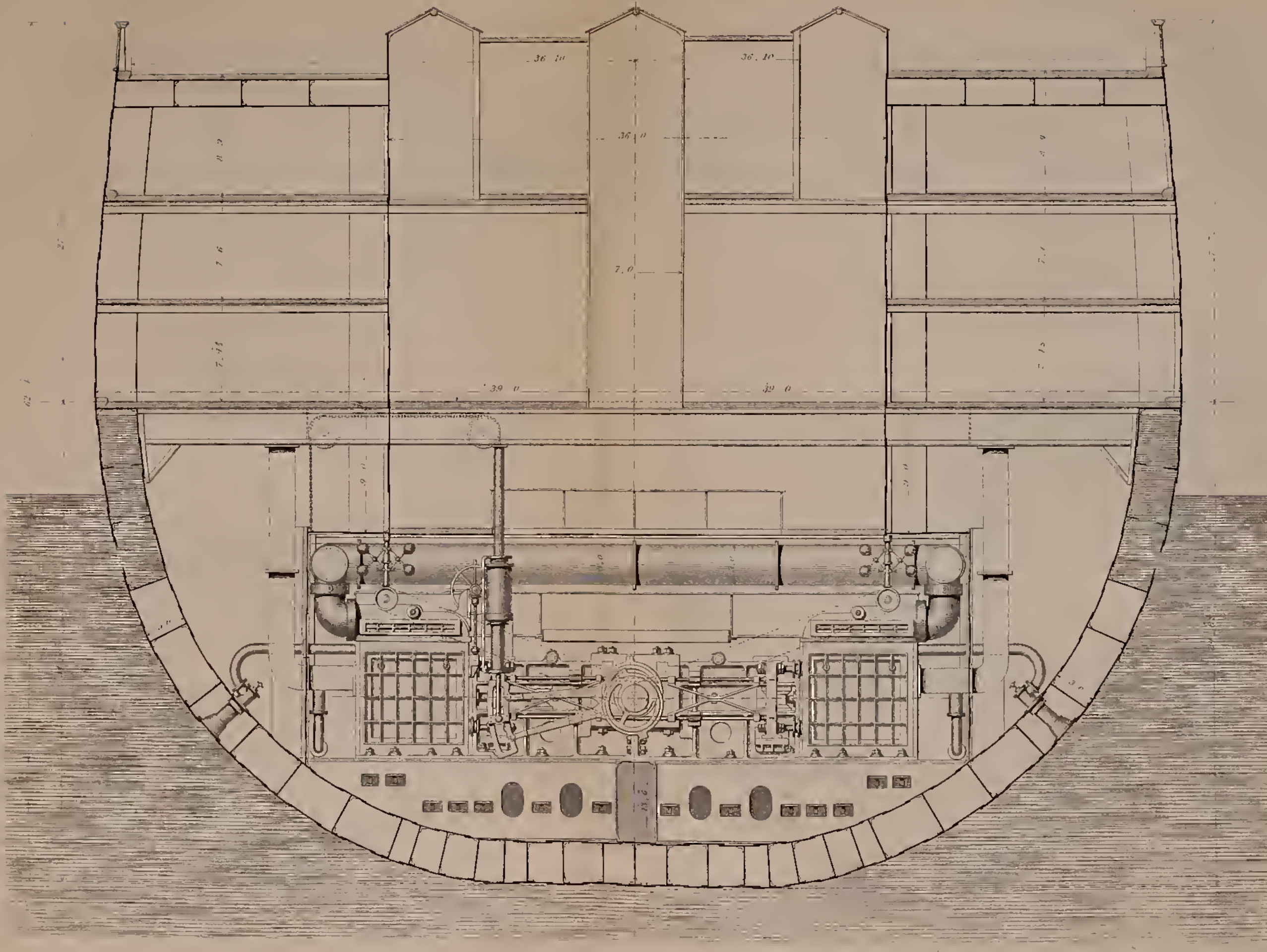


Scale 1/360th 0 5 10 20 30 40 50 60 70 80

William Smith, C. E. direx.

THE EASTERN S. N. Co's GREAT SHIP.

PLATE No I.



Wm Smith C.E. direxit

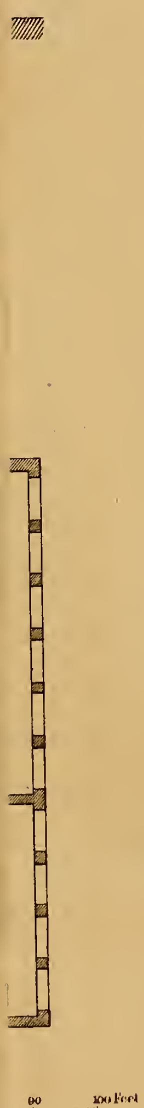
Inches ... Feet

W. A. Beever Sc

PUMPING ENGINE.

BY

AM FAIRBAIRN F. R. S.



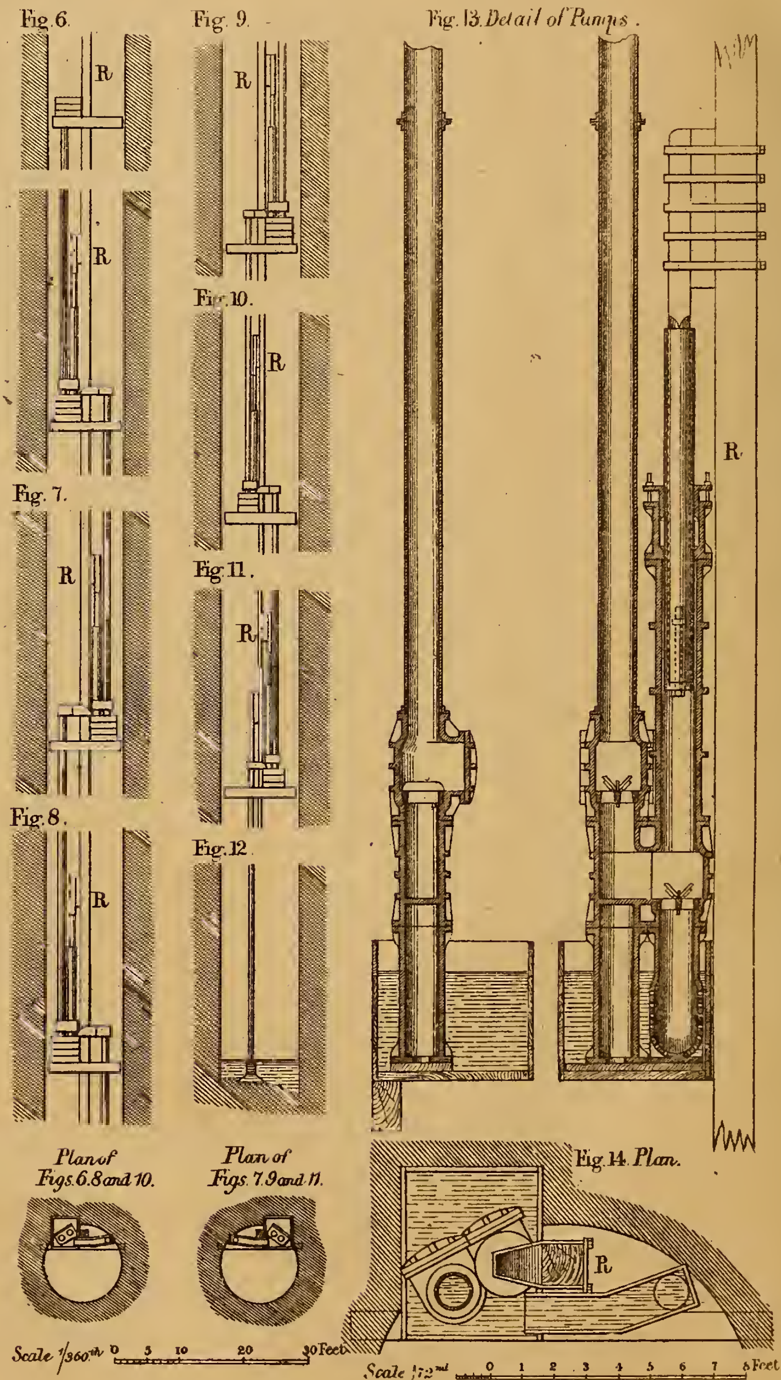
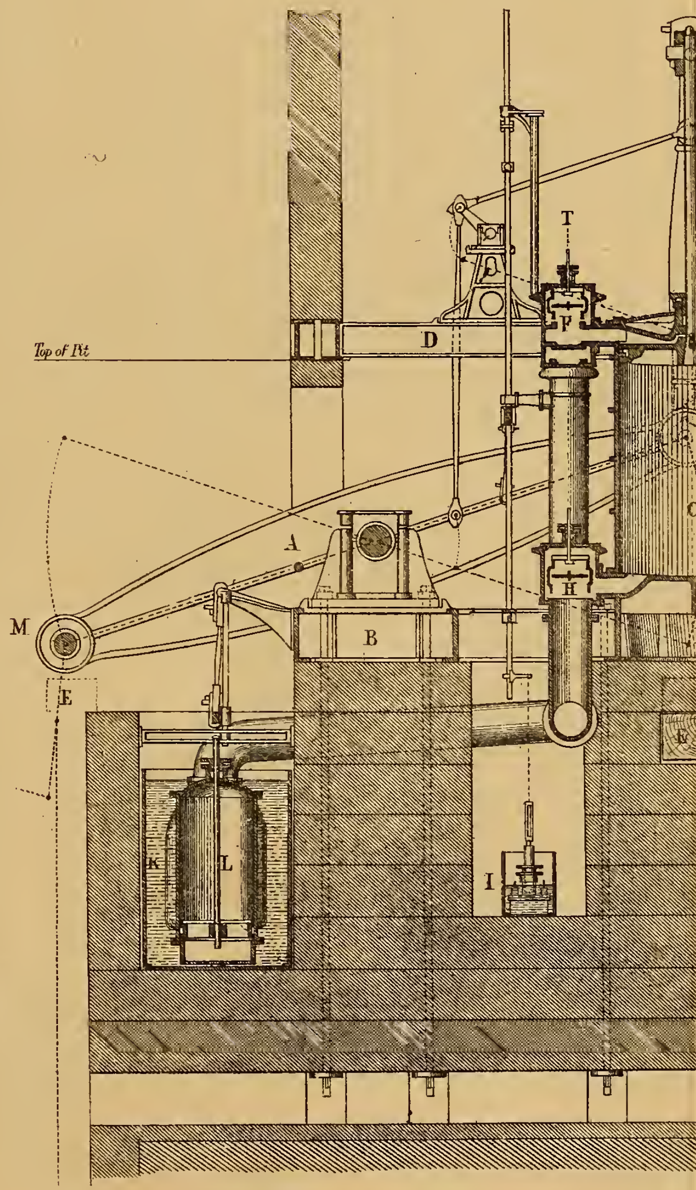


Fig. 1. *Longitudinal Section of Engine.*



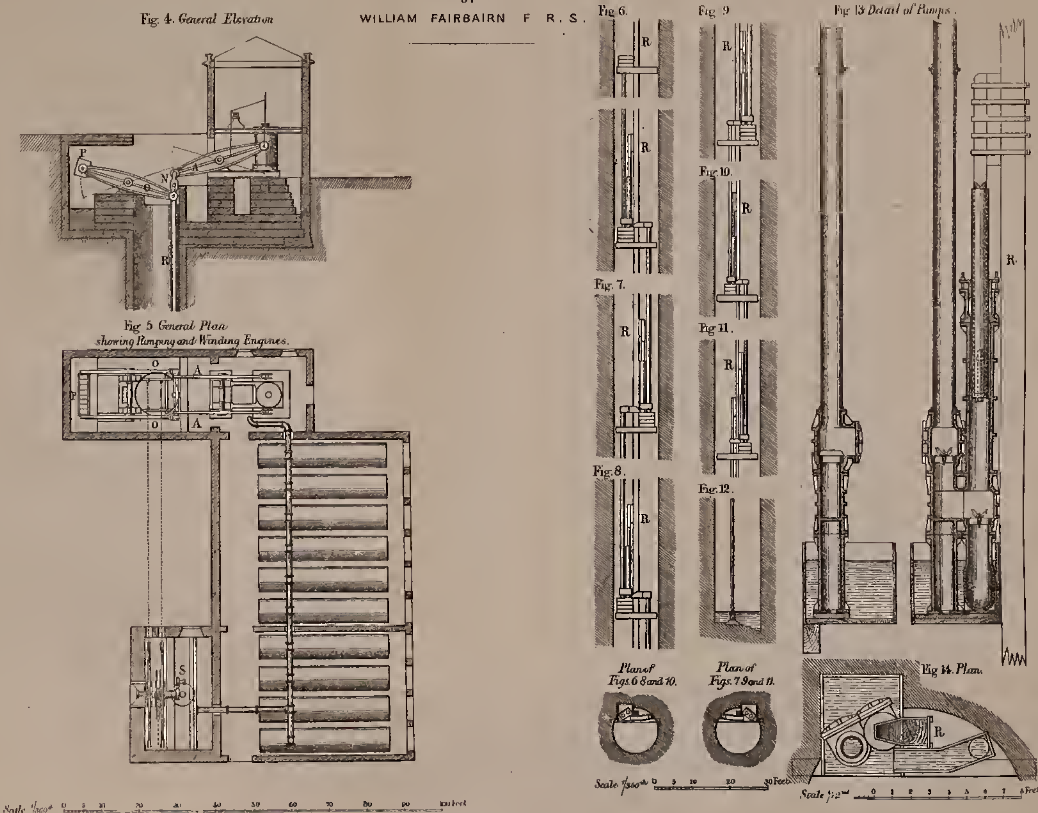
Scale 1/90th   0   5   10   15

William Smith, C. E. direx.

NEW PUMPING ENGINE.

BY

WILLIAM FAIRBAIRN F. R. S.



William Smith, C. E. direx.

NEW PUMPING ENGINE.

BY

WILLIAM FAIRBAIRN, F. R. S.

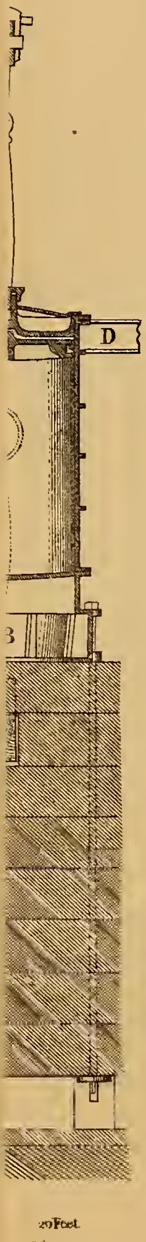
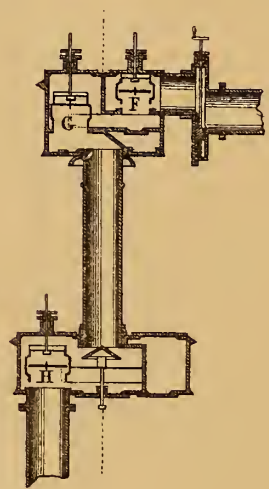
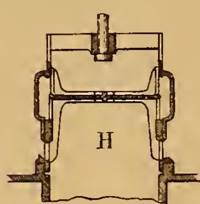


Fig. 3.

Section of Valves. at T in Fig. 1.

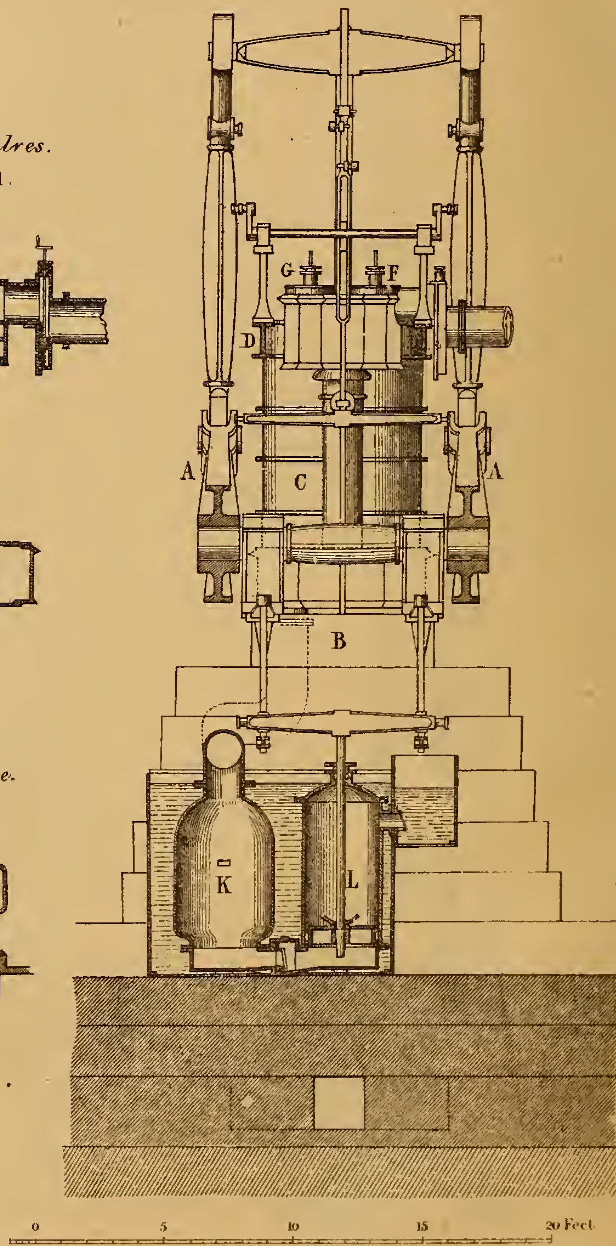


Detail of Valve.



Scale 1/30th

Fig. 2. *Transverse Section of Engine.*



Scale 1/90th

THE ARTIZAN.

No. CLXI.—Vol. XIV.—JUNE 1st, 1856.

THE EASTERN STEAM NAVIGATION COMPANY'S GREAT SHIP.

For several months past we have been preparing a series of Plates of the great ship and its machinery, and with the present Number we give the first of the series. Plate lxxiv. is a transverse section of the after part of the hull of the great ship, exhibiting the peculiarity of her construction, and showing accurately a side view of the engines and machinery for driving the screw propeller, the scale being ½-in. to 1 foot.

These immense and splendid specimens of marine engineering have been designed and constructed by Messrs. James Watt and Co., of Soho, near Birmingham. The following are the principal dimensions of the engines, boilers, screw propeller, &c., as furnished to us by the manufacturers. We have to observe that the drawings have been made by us from the detached details and working drawings of the engines, boilers, and machinery, and the accuracy thereof may be relied upon. As to the details of the vessel and the peculiarities of her internal arrangements, we shall hereafter give accurate particulars.

There are four cylinders, 84 in. diameter by 4 ft. stroke, and the ordinary speed is to be 45 strokes per minute, at which the nominal power is 1,700 H.P.; but at 50 strokes per minute, and at which the engines will go with steam of 25 lbs. pressure, the power will be quite 2,000 H.P. The weight of the engines alone is about 500 tons.

There are to be three sets of boilers to work the screw engines, each set having a surface of 8,500 sq. ft., say 1,680 brass tubes 3 in. diameter outside, and 5 ft. 6 in. long. The grate surface is 406 ft. The weight of each set is 190 tons, including 90 tons of water.

The screw is 24 ft. diameter, and 37 ft. pitch; the propeller shaft is 24 in. in diameter, and 48 ft. long, and weighs 35 tons. There is an ingenious arrangement by which the after screw bearing may be cottered up and adjusted at pleasure. This is effected by a separate chamber—in fact a "diving bell"—and from which the air is expelled in the usual manner by pumps, thus allowing an engineer to descend and do what is necessary. This is shown in the longitudinal section (Plate No. 2 of the series), which will be given in our next.

The velocity of this ship was never intended to be of the highest class, because the possession of capacity for storing sufficient fuel on board for a voyage to Australia and back, gives a great advantage in making a *direct* passage without stoppage of any kind usual with other ships of less capacity, and that therefore a less *average* velocity would answer all calculated purposes. Supposing, therefore, the draught of this ship to be (when loaded and ready for sea) 28 ft., the area of the midship section will be 2,000 ft.; and if we infer that the *actual* power exerted by the combined engines will be equal to 10,000 H.P., and further supposing the power to increase as the cube of the velocities, we find, from experience in practice, the velocity under such circumstances will be 17 statute miles per hour. By the same rule we find the paddle engines will give the ship a velocity of 12·55 statute miles per hour, and the screw engines alone will give a velocity of 14 statute miles per hour.

But this supposes no *drag* to take place from the immersion of paddle-wheels in the one case and of the screw in the other. To obviate the retention arising therefrom, it is arranged so that the paddle-wheels may be easily detached from the engines, and be allowed to revolve freely in the water.

In the case of the screw, perhaps a more complete scheme has been devised for this purpose.

Two engines, each of 20 H.P, are to be fitted, and which can be readily attached and detached from the screw-shaft at pleasure, a self-acting clutch is also to be fitted to the large screw engines, by which they can be readily disconnected from the screw-shaft. It will then become the duty of the small engines to work the screw at a reduced velocity equal to that given to the ship by the paddle engines *alone*. As a recapitulation of the various steam powers to be employed in this gigantic work, we may observe that in all there will be on board no less than twenty-two engines of various powers.

Say, the four engines for working the screw of	1,700 H.P.
Four ditto, ditto, paddle-wheel.........	1,350 H.P.
Two engines for working the capstan, getting up anchors, and pumping out ship, &c.	60 H.P.
Two engines for working screw alone, having separate boilers and services	40 H.P.
Ten donkey engines for filling up boilers, not to be used for other purposes, and each engine of about 10 H.P.	100 H.P.
Total	3,250 H.P.

In all 22 engines of the aggregate power of 3,250 H.P.

The large screw engine will be fitted with a separate steam cylinder, by which it is presumed these large masses can be started and reversed with the greatest ease and certainty.

In presenting our readers with a series of Plates of so interesting a work, we propose, in the course of the present and following Numbers of The Artizan, to give a sketch of the origin and progress of the undertaking, as we feel that it is due to the talented designer of this bold experiment in, and gigantic specimen of, naval architecture, as also to those connected with him in practically working out the great problem to be solved, as also to those who, aiding and assisting the undertaking commercially, thus enable the engineering talent of this country to maintain its supremacy over the combined skill and talent of the whole world.

Originality of conception, boldness of design, combined with the consideration and accurate arrangement of practical details, are but seldom combined in one man; but the name of Brunel has been so often associated with things original, bold, and practical in science, that whether we look to the great works of the father or the more modern, and, perhaps, more commercial achievements of the son, we must confess to the feeling that whatever money can be provided for, the original mind, talent, enterprise, skill, and practical ability of a Brunel can unfailingly work out, however bold and problematical such schemes may at first sight appear.

To Mr. Isambard Kingdom Brunel is due the credit of originating the bold design of which we have undertaken to give our readers a general description, illustrated by a series of expensive copper-plate engravings. It is now twenty years since Mr. Brunel's first Transatlantic steam ship,

NEW PUMPING ENGINE.

BY

WILLIAM FAIRBAIRN, F. R. S.

Fig 1. *Longitudinal Section of Engine.*

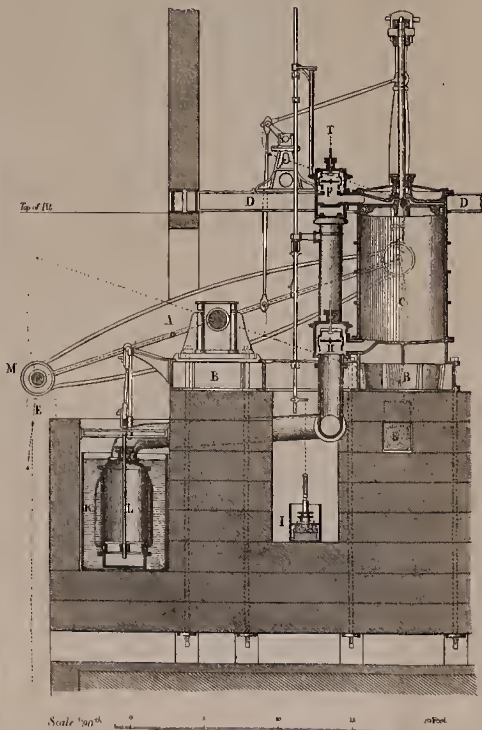
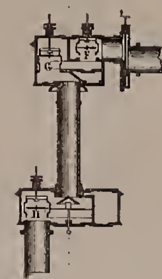


Fig 3

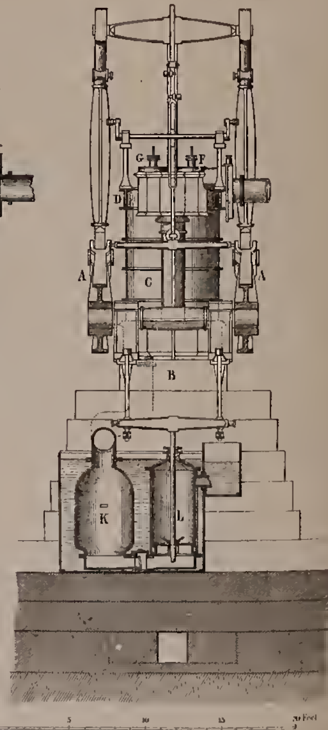
Section of Valves.

at T in Fig 1.



Detail of Valve.

Fig. 2. *Transverse Section of Engine*



the *Great Western*, was designed. It was thought at the time a bold stride to increase the dimensions of that ship by 50 ft. in length and about 8 ft. in breadth over the largest paddle-wheel steamer then afloat, but the prophesied fate of the *Great Western* was proved to be unfounded and untrue upon her first voyage; and we have seen the progressive increase in the dimensions of our steam ships which has gone on during the last few years. The giant of 1838 has become the pigmy in 1856. Omitting the Great Eastern ship, we can compare the *Great Western*, 236 ft. × 35 ft. 6 in., with the *Great Britain*, 322 ft. × 51 ft.; the *Himalaya*, 370 ft. × 43 ft. 6 in., and, lastly, the *Persia*, 390 ft. × 45 ft. But beyond these Mr. Brunel's great ship shoots far ahead, being laid down at 680 ft. × 83 ft.

Mr. Brunel seems to have determined to settle the question of whether or not steam ships are to maintain their well-earned superiority over clipper sailing ships when employed upon world-round voyages, as they have heretofore done on Atlantic, Mediterranean, and other voyages of similar extent. And in looking about for the cause of the failure of the steamers employed in the Australian route to make such voyages in less time than clipper sailing ships or vessels fitted with auxiliary steam power, and also to make such voyages commercially profitable, he saw that the views he held twenty years ago with reference to the Atlantic trade were applicable, in an eminent degree, to India and Australian voyaging, *viâ* the Cape, and determined to increase the carrying capacity for *fuel* to such an extent as to make his new ship independent of supplies to be derived from coaling depôts during her voyage, to which coaling stations the fuel has to be sent by many ships at a vastly increased cost per ton, and is much damaged by the transhipments and breaking of bulk necessary under such circumstances. The estimated quantity of 5,000 to 6,000 tons of coals necessary for the voyage out and home involved other increases of dimensions, calling in turn for the proper proportioning of strength or power to suit these new conditions of things, and admirably does Mr. Brunel appear to have considered the every detail and bearing of the question. And we look forward to the time when the successful launching of this monster ship will be but the first of a series of triumphs for this great work, and we sincerely hope we shall be one amongst the first voyagers invited to give the world the best proof of their entire confidence in the skill and talent of the designer—in the excellence of the workmanship and materials of the contractors—in the perfect safety of the ship at sea—and in the success of the experiment in a practical and scientific point of view.

In our next we shall give, in continuation, a sketch of the progress of the work, and our second Plate will exhibit a plan of that portion of the ship containing the engines, boilers, and machinery for driving the screw-propeller. Of the details of these engines we intend hereafter to give a minute description, possessing, as they do, many features of interest and novelty, and eminently creditable as they are to the celebrated firm of James Watt and Co., by whom they were designed and manufactured.

In our second Plate of this series every dimension is accurately figured upon each part.

COOK'S STEAM PUNCHING, SHEARING, AND RIVETTING MACHINE.

Manufactured by Messrs. D. Cook and Co., Engineers, Glasgow.

We have much pleasure in calling attention to this ingenious arrangement of machinery for performing the three operations of punching, shearing, and rivetting within the same frame, as represented in the accompanying Plate, No. lxxiii. It will be found an exceedingly useful addition to the machine-tools of the engineer and boiler maker's shop.

As regards punching and shearing, it has advantages over machines that are driven with wheel gearing, as the attendant never admits the steam until the plate operated upon is set in its proper position; consequently, the holes are more correctly punched than with those machines driven with wheels, because they are constantly going, and if the plate is not set at the proper time the hole is punched in the wrong place. The machine can punch at the rate of thirty holes per minute with great ease. The rivetting by this machine is much superior to hand work; it is executed with much greater rapidity, as by hand labour three men take three minutes to one rivet, and by this machine the same number of men can put in six rivets in one minute. It is also economical in point of driving power, as the machine is not consuming any steam unless actually doing work, while machines driven with wheel work are kept constantly going. A steam-pipe from a small high-pressure boiler is all the connexion that the machine requires, and steam at 20 lbs. pressure is sufficient to work it.

DESCRIPTION OF THE DRAWING.

Figs. 1, 2, and 3, show three side views, and Fig. 4 a plan, partly in section, of apparatus arranged for punching, shearing, and rivetting. In each of these figures the same letters indicate like parts, wherever they occur.

In the side view (Fig 3) the apparatus is shown in the act of rivetting a boiler, or other such vessel.

a is the steam cylinder, the form and mode of operating with which may be varied, but that which is here employed has a hollow piston-rod, a^1, the connecting-rod, a^2, of which is connected to one end of the lever-arm, *b*, affixed to, or formed with, the axis or shaft, b^1, and upon which is also formed the eccentric, b^2, which, by straps, b^3, is connected to the slide, *d*, carrying the rivetting-die, d^1, for effecting, in combination with the "holder-on," *e*, the operation of rivetting; the holder-on, *e*, is firmly fixed, as shown, to the bed-plate of the machine, and sustains the counter-die, e^1.

According to the arrangements shown, the eccentrics, b^2, are formed on the enlarged end of the lever-arm, *b*, which is affixed to the shaft, b^1 by keys; but these details may be varied.

The shaft or axis, b^1, is securely held with a capability of partial rotation in the main framing, as shown; *c* is the punch-holder, which is capable of sliding freely in guides carried by the framing of the apparatus, and it is operated by means of a stud-pin, c^1, placed eccentrically in that end of the shaft or axis, b^1; and in the other end of this shaft or axis, b^1, is another stud-pin, f^1, also placed eccentrically, for operating the upper cutter, f^2, of the shears, *f*; *g* is a rocking-shaft, with handle, g^1, for the purpose of effecting the stopping and starting of the apparatus.

The valve is worked to admit the steam to, or cut it off from, the cylinder, *a*, by the attendant acting upon the handle, g^1, which is formed with a socket at one end to take on to the short-arm, g^2, formed on, or affixed to, the shaft or axis, *g*, upon which is formed the arm g^3, connected to the rod of the slide-valve.

And in order to prevent injury to the parts by the too sudden descent of the piston in the cylinder, after each operation of either or all the instruments is completed, a small quantity of steam is retained in the cylinder to act as a cushion to the piston. To one of the straps or rings, b^3, is attached, by a pin joint, one end of the short link, *h*, the other end of which is attached to the upper end of the lever-arm, *i*, affixed to the end of the axis, i^1, at the other end of which is affixed the arm, i^2, to which, by a pin joint, is connected one end of the rod, J, and in the lower end of this rod is formed a slot, J^1, to receive a pin from a short arm, K, from the axis, *g*, and the parts are so arranged that the arm, K, may be operated upon to admit a small quantity of steam to the cylinder just before the piston descends to the bottom of its stroke, and then to stop it off again; the steam thus admitted acts as a cushion to the piston.

We shall have occasion shortly to allude again to this invention, and give some practical examples of its successful working.

DESCRIPTION OF THE DRAINAGE OF THE HAARLEM MERE.

There is no land which, like the western districts of the Netherlands, called North and South Holland, has to use such means for defending itself from the sea, whose impetuous waves at many times threateu to recover the ground which, by the unremitting labour of men, has, pace by pace, been conquered by them. For a stranger not accustomed to this aspect, it must be most astonishing to see the labourer peaceably cultivating the rich soil, and the fine cattle covering the mild pastures, when he is informed that at the time of high spring-tides, with the wind blowing hard, on the giving way of the barrier defending the country from the sea, some of the lowest lands would be covered with a depth of water of no less than 7·90 met. (about 26 feet). The greatest part of these lands have, by art, been changed from stagnant pools and marshy grounds into the most precious lands, the position of which, however, necessitates a constant application of artificial means to keep them dry. An idea may be formed of the extensive drainage works performed in the two above-named districts, from the statement, that since the year 1440 until the present time no less than 107,490 hectares (261,123 acres) have been converted into magnificent land. These lands requiring a good discharge for their surface water, the districts have been divided into under districts, which, though subjected to Government, have the direction of their own waterways, for their maintenance in good order, and, generally, to watch over their interests. Such an under district is called *Waterschap*, which has often a great extension. These under districts contain one or more reservoirs, natural or artificial, being their catch-water, or so-called *boezem*. These *boezems* have to fulfil different duties, one of the greatest being to collect the superfluous water during high tide, and discharge it when the level of the sea or river into which it is to be discharged has fallen enough for this purpose. Also, in very dry summers, they are to retain a sufficient quantity of soft water for the fields and pastures, and for the communication by water. The higher lands discharge their water into these *boezems* by lying on a higher level; the lower lands, which are separated from them by dykes, discharge their superfluous water by artificial means into these *boezems*, which communicate with the sea or adjacent rivers by sluice-gates.

The under district or *Waterschap*, in which is the late Haarlem Mere, is called *Rhynland*, having an area of 123,500 hectares (305,185 acres), of which, before the drainage of the mere, 22,700 hectares (56,095 acres) were *boezem*, 30,740 hectares (75,962 acres) high lands, and 70,060 hectares (173,128 acres) lands which are artificially kept dry.* The accompanying map† represents this district as it is, confined on the north side by the Y, being a branch of the inland sea, called the *Zuider Zee*, on the west by the North Sea, on the south by the under districts or *Waterschappen*, *Delfland*, and *Schieland*, and on the east side by high lands.

It is enclosed, almost totally, by embankments; the defence against the North Sea, however, cousisting chiefly in natural downs, though, in some points, as these were wanting, the defeuce had to be completed by artificial embankments, requiring an unremitting care and heavy expense. The means of discharge of *Rhynland* are confined to three points—viz., one on the Y at *Spaarndam*, by four sluice-gates, having a collective breadth of 23·96 met. (78 ft. 7½ in.), and at *Halfweg* by three sluice-gates, having a collective breadth of 17·61 met. (57 ft. 9½ in.); two on the North Sea at *Katwyk*, by a sluice-gate, with three apertures, having a collective breadth of 16·95 met. (55 ft. 7½ in.); and three on the river *Yssel* at Gouda, by three sluice-gates, measuring together 19·10 met. (62 ft. 8 in.). The *Yssel* discharges itself into the river *Maas*, which falls into the North Sea. On inspecting the map, it will be readily observed that by the situation of the points of discharge, this district has almost always the facility of discharging its surface water, for when heavy winds from the west and south-west drive the water to the coast along the North Sea, the water on the north coast, on the contrary, is driven away. When, on the contrary, the water of the Y is being sent up by heavy easterly winds it is driven from the coast of the North Sea, whereby the sluice-gates at *Katwyk* draw off the water, though the *boezem* in this case is not lowered so much in the same time as by the discharge on the Y, owing to the lesser breadth of the sluice-gates and the louger and more tortuous way by which the water has to go. The sluice-gates at Gouda discharge very little water, owing to the gradual rising of the river bed.

After these preliminary remarks, which were necessary to a proper understanding of this subject, we may proceed to describe the different works executed to drain the Haarlem Mere.

This mere, lying on the north side of *Rhynland*, had not always the great extent which it had at the time of its drainage. The earliest existing map informs us that in the year 1531 there existed no more than four little meres, that there were different roads, and three villages, which at the time of the drainage being commenced had been swept away, and the surface covered with water. These four meres, of which the position is shown on the map by dotted lines, had, perhaps, no greater surface than about 6,000 hectares. In the year 1591 one of the villages had already disappeared, and the four meres had extended to a single one. In 1647 the two other villages were drowned, and the (until then not existing) *Kager Mere* on the south side was formed; the mere at that time covered an area not much less than at the time of its drainage. The mere extending itself more and more, necessitated incessant renewals of the works constructed to limit its further extension, and the construction of new ones; even so that during many consecutive years no less than from 30,000 to 40,000 florins (£2,500 to £3,300) had to be expended. It was now more to be feared that the mere would unite with the smaller meres adjacent to the east side, which would have been a calamity of which the consequences would have been of the most frightful character.

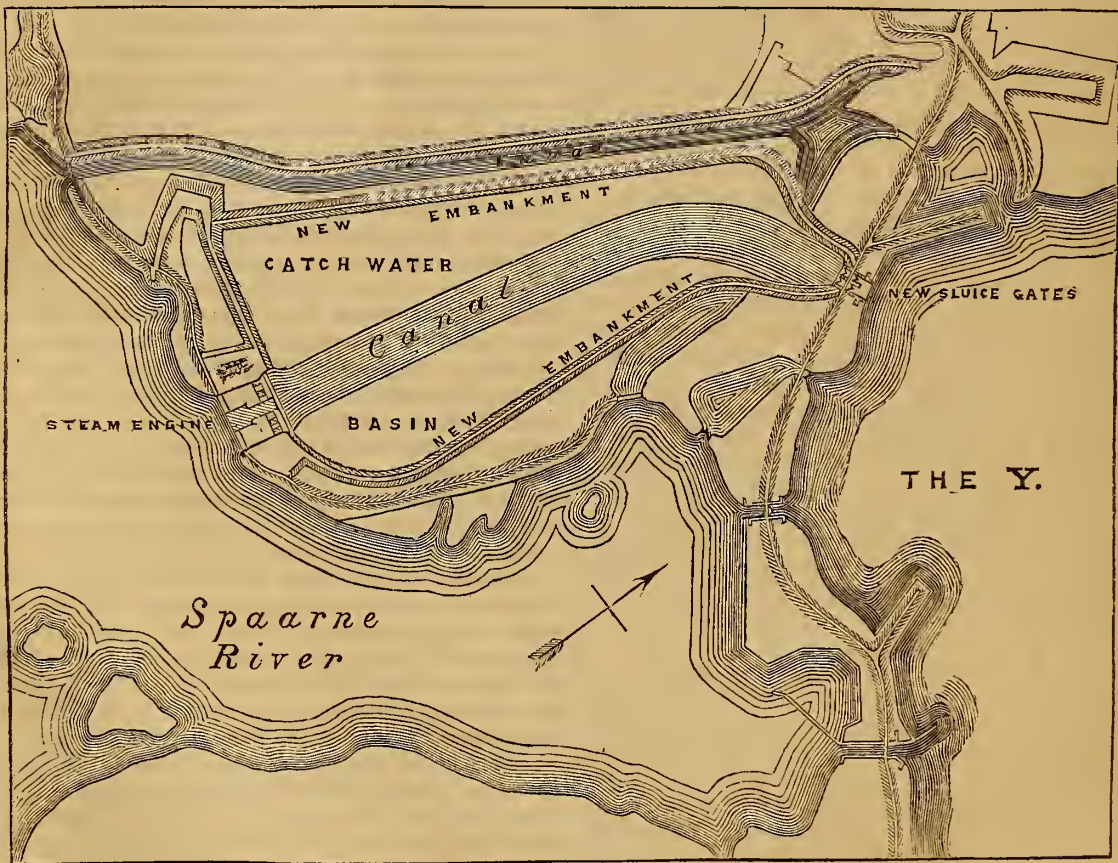
As early as the year 1617 a plan was formed to drain the lake, which was renewed in 1631, but without any success. In 1643 a talented millwright, named Leeghwater, having very successfully performed many operations of this nature, produced an elaborate plau for the drainage of the Haarlem Mere, to be executed by surrounding the mere by an embankment, on the outside of which was to be formed a channel for the purpose of isolating the waters of the mere from those of the surrounding country, and conveying them to the existing points of discharge. The draining was to be performed by 160 windmills, in four rows, each lower row bringing the water to a higher one, which again lifted it to the third row, by which it was to be raised to the fourth, discharging it finally in the channel. The enclosure was to cover an area of 17,000 hectares (42,000 acres), the probable cost being calculated at 3,690,000 florins (£307,333). This plan exhibits much ingenuity, and was the basis on which the great number of subsequent plans were formed. No less than fifteen different plans, more or less practicable, were formed in the two centuries since the first great plan of Leeghwater was published, succeeding each other at smaller intervals, according to the greater extension of the lake, until, in 1836, the heavy storms in November and December decided the fate of the lake. On the 29th of November of this year a heavy storm, blowing from the west, swept the waters under the walls of Amsterdam; while, on the 25th of December, by a violent storm from the east, the waters inundated an immense tract of land on the side of Leyden, while even a portion of that city was drowned by the irresistible waves. Many of the lower lands then inundated remained in this position during more than a year. This fixed once more the attention on the necessity of the drainage of the mere; even so that in August, 1837, by a royal decree, a commission was assigned to examine the then existing plans of drainage, and to report on it before November of the same year.

* Of these high lands, 11,400 hectares are sand hills or downs, being a natural barrier against the sea, so that 19,340 hectares only (47,790 acres) are cultivated.

† This map will be given in our next.—Ed.

This commission had finished its task as early as the end of October, and offered its report, of which the principal points were as follow :—

The discharge of the water from the mere should take place on the *boezem* of *Rhynland*, for if the water should be discharged on the Y and the North Sea by particular channels, it would involve almost insurmountable difficulties. The *Spiering Mere* (shown on the map, on the north side of the mere) should not be drained, but reserved as catch-water, for assisting the discharge by the sluices at *Halfweg*, to which a fourth was to be added, for the wind, blowing on a great surface before the sluice-gates, assists considerably in urging the discharge of water, which is not the case in a narrow canal which, besides, has the disadvantage of occasioning a great difference of level at different points. One of the first points of consideration was the care for a ready discharge, which was the more necessary, as while, by draining the Haarlem Mere, the *boezem* of *Rhynland* should be reduced to about one-fourth; therefore, it was recommended by the commission to improve the sluice-gates at *Katwyk*, and to widen its canal leading to the mere. Moreover, they proposed improving and deepening the river *Spaarne* (shown on the map), and erecting a steam-engine at Spaarndam of 180 H.P., with a sluice-gate for discharging its water. This engine had to raise the water on the Y at the time of high winds or high tides impeding a natural discharge. The lake had to be enclosed by an embankment, which, again, was surrounded by a canal, serving as an outfall for the waters to be raised, and, at the same time, being of such a capacity as to offer ample facilities to the navigation. This embankment was to have a length of 49 kilometers (30·44 miles) ; the canal



to have a breadth of from 35 to 40 met. (115 to 130 ft.), and a depth of 3 met. (10 ft.) The commission proposed to drain the lake by windmills, with auxiliary steam-power. They recommended two rows of 32 mills (actuating Archimedean screws) and three rows of 5 mills each (actuating inclined flash-wheels), so that the total number of mills should amount to 79. Moreover, they proposed the erection of three steam-engines, of 40 H.P. each (actuating Archimedean screws), to be placed each in the neighbourhood of one of the points of discharge. They valued the cost at 8,355,000 florins (£400,000, nearly), besides 400,000 florins (£33,000) for unprovided works.

Many difficulties and obstacles had to be surmounted before the execution of such an enterprise was finally fixed; and it was not until the 22nd of March, 1839, that a royal decree was passed, ordering the drainage of the Haarlem Mere to be executed by the Government in the manner of all public works, and that the plan of 1837 should be followed, save any alterations to be fixed afterwards.

A commission was appointed for superintending the works, composed of eleven members, of high standing in society, and of scientific attainments being partly Members of Parliament and partly Royal Engineers. After some alterations, this commission finally consisted of thirteen members, of which Mr. D. F. Geversran Endegeest was elected as chairman. Afterwards two Royal Engineers, Messrs. P. Koek and J. A. Bijerinck, were appointed for the execution of the works, the task being a most difficult one, but one which they have executed in the most laudable manner.

It being determined that this gigantic work should be undertaken, notwithstanding the many claims from different sides, arising from ignorance or ill will, and which are called forth by every great enterprise, the commission began its heavy task with great vigour and courage. Many alterations were made in the previous plan, and when at last the final plan was issued, it contained the following leading points:—

The drainage of the entire mere (including the *Spiering* and *Kager Meres*), covering a surface of 18,100 hectares (44,727 acres), and having a mean depth of 4 met. (about 13 ft.)

Surrounding the mere by a continued embankment, having a length of 59·5 kilomet. (37·5 miles nearly), of which a length of 2,780 met. (9,120 ft.) had to be formed through the water.

The formation of a large canal for the discharge of the water and the navigation, which, besides, had to receive all the water previously discharged into the mere; the formation of embankments wherever the canal happened to intersect low lands, for isolating these lands from the canal; constructing bridges over the canal for the communication with the lands to be afterwards reclaimed from the mere.

The discharging of the water to be raised by means of the above-named canal on the *boezem* of *Rhynland*.

To provide by adequate means for the discharge of this *boezem*, which was considerably to be reduced by the drainage of the mere, and which, without such means, would rise to too high a level. This had to be effected—1st, by improving the outfall at *Katwyk*; 2nd, by widening and deepening the river *Spaarne*; 3rd, by erecting a steam-engine of at least 180 H.P. at *Spaarndam* for raising the water from the *boezem* on the Y when the natural discharge should happen to be interrupted by some cause or other; 4th, by constructing a fourth sluice-gate at *Halfweg*.

Providing the means for furnishing soft water in very dry summers, it being proposed to attain the same by making a communication with the river *Yssel*.

Constructing different works for the use of the navigation, and compensating for the greater distance which ships had to go by following the intercepting canal.

Providing means for compensating the loss arising by the drainage of the mere to the system of defence of Amsterdam by inundation.

The division of the mere after the drainage; the forming of canals; construction of roads and bridges.

Such were the leading points of the plan to be followed in draining the mere, and according to which the drainage has been performed.

We will subsequently describe the different works in the order in which they have been executed.

Before anything could be done, the commission had to obtain possession of the different grounds adjacent to the mere, and necessary to the execution of the works. This has been executed without much difficulty on the part of the proprietors, who have generally transferred them for reasonable prices, the total expense having been 706,373 fl. (£58,880). Being in possession of these grounds, the first thing to be done was the providing means for a good discharge of the waters. It was resolved to begin by improving the waterway from the mere to the sluice-gates at *Katwyk*, which was very tortuous and narrow, the greatest part being a small existing stream, and a small part, nearest to the sluice-gates, being made by art, but of too small a capacity. It was resolved to rectify the stream and to give it the necessary capacity, as also to enlarge the existing canal. The new canal has a length of 4,235 met. (4,631 yards), the breadth at the surface being 40 met. (131 ft.); breadth at bottom, 31·20 met. (102 ft.); average depth, 2·20 met. (7 ft. 2½ in.) The cost has been 33·05 fl. per running met. (£2 13*s*. 7·8*d*. per yard). Three bridges had to be constructed on this new canal, and two bridges on the existing canal had to be lengthened in consequence of its enlargement, which took place a short time afterwards. Lastly, the three existing sluice-gates had to be augmented by two new ones, so that their total width was augmented to 23·73 met. (77 ft. 10 in.) By these works a spacious outfall for the waters on the North Sea was provided for, while, in the mean while, works were undertaken to insure a good discharge of the superfluous water on the Y; therefore a great number of shoals in the river *Spaarne* had to be removed, while at the same time a towing-path was constructed along this river from the mere to *Spaarndam*. Before the drainage of the mere could begin, all the works for the discharge of the water had to be finished, and accordingly the steam-engine at *Spaarndam* had to be erected before the total enclosure of the lake could be performed. After many considerations it was determined that this steam-engine should be placed at any distance from the sluice, in the great embankment separating the river from the Y, and that a short canal should be formed for the communication of the engine with the sluice-gate. The position of the engine and the different gates is represented in the adjoining sketch (Fig. 1), which needs no explanation. The engine is double-acting, with horizontal cylinder, and is condensing. The steam-cylinder has a diameter of 1·52 met. (60 in.), with a stroke of 3·04 met. (10 ft.) Four boilers, with internal flues, having a diameter of 1·65 met. (5 ft. 5 in.), and a length of 11·50 met. (37 ft. 1 in.), furnish steam to the engine, which moves five flash-wheels on each side.

These wheels, having a collective breadth of 22 met. (72 ft. 2 in.), can be moved together, or any number may be moved, according to the height to which the water has to be raised.

Experiments made with this engine have proved that the difference of level of the water being about 1 met. (3 ft. 3 in.), with only four wheels, having a collective breadth of 10 met. (32 ft. 10 in.), the volume of water raised was 843 cubic met. (29,771 cubic ft.), or 84·3 cubic met. (2,977 cubic ft.) per minute for each metre in breadth of the wheels. Different circumstances and difficulties delayed the erection of this engine, which was constructed by Messrs. Dixon and Co., at Amsterdam, though it was finished long enough before the drainage of the mere was commenced. On the 26th of November, 1846, it entered on regular service, and since that time until the completion of the drainage of the lake in July, 1852, it has raised from the *boezem* of *Rhynland*, on the Y, no less than 923 million cubic met. (1,207 million cubic yards) of water in about 13,000 working hours, or nearly one million cubic met. more than the three powerful engines for emptying the lake discharged on this *boezem*. This is a proof of the great boon this engine is to the district, for when the *boezem* threatens to rise to too high a level, by the combined action of the three engines, and of 261 windmills discharging the surface water of the surrounding country on the same *boezem*, already considerably reduced, when the Y happens to be at too high a level for natural discharge, the discharge is, nevertheless, accomplished. The gate has two sluices, measuring together 14 met. (46 ft.), and is so constructed that ready means are provided to inundate the adjacent country, in case of need, for the defence of the capital.

During the construction of these works, which regarded but the improvement of the discharge of the *boezem*, the works for the drainage were duly undertaken, commencing with the enclosure of the lake. The embankment and the surrounding canal had to be formed simultaneously, for the ground arising from the formation of the canal had to be used for the formation of the embankment. It was determined to follow the course of the banks, save in those places where the angles should be too great, so that at those points the embankment had to be constructed in the water.

(*To be continued.*)

SUGGESTIONS FOR THE IMPROVEMENT OF THE RIVER DANUBE, BETWEEN ISATCHKA AND THE SULINA ENTRANCE.

By G. B. Rennie.

The interest which the Danube has lately excited in the affairs of Europe, the importance of its navigation, and the partial stoppage of its most important outlet—the Sulina entrance—has suggested the following remarks on the means of improving the depth of the channel, and of keeping it perfectly open.

The importance of the question has been lately increased, from the free navigation of the Danube having been, in the articles 15 and 16, stipulated by the Allied Powers of Europe in the treaty of peace with Russia.

Before entering on the subject of improving the navigation of the river, it is necessary to describe, in a general way, its nature, and the means formerly adopted for keeping the channel clear.

The basin of the Danube and its tributaries is estimated to comprise (according to M'Culloch's Geographical Dictionary) one-thirteenth of the whole of Europe, and the lower part of the Danube or Ister is navigable for vessels of considerable draught of water for the greater part of the year, the only obstruction in its channel being what is called the Iron Gate at Orsova, which is in course of removal under Austrian superintendence.

The Danube, like most large rivers which discharge their waters into seas without tides, distributes itself into many branches, forming a Delta. The principal of these branches are the Sulina, Mortizza, Killia, and St. George's; the most important and frequented of these is the Sulina, which has been partially stopped up from neglect, but principally from political causes; it is, therefore, extremely desirable that some means should be adopted for permanently keeping this channel open.

At the mouth of the Sulina branch and each of the other outlets a bank or bar is formed. This is occasioned by the light soil and sand brought down from the upper parts of the river and its tributaries being held in suspension by the force of the current until it enters the sea, when, the water becoming slack, the particles of earth sink to the bottom, and form the bank or bar.

The water upon the bar varies from 8 to 11 ft. in depth, according to the force and direction of the wind, which, when north-easterly, keeps back the water, but which also increases the bar, for it is ascertained there is less water with the north-easterly than with a westerly wind, or during calm weather. The prevailing winds are N.E. and S.E., but the winds from the N.E. are most violent, and cause most damage to shipping. The force of the stream downwards is about two and a half miles per hour. There is also a slight current upwards from the north, which runs along the coast of the Black Sea at this part.

The improvement of the entrance of the Sulina channel has been a consideration with different Governments interested for many years. The Turks, during the time they held possession of the Danubian provinces and entrances of the Danube, procured a depth of from 16 to 17 ft. The means adopted by the Turkish authorities were raking the bottom of the channel, which had the effect of stirring up the soil, which was then carried away by the force of the current. A palisade was also constructed, which contracted the channel and gave greater force to the current.

When the Russians, by the treaty of Vienna, took possession of the mouths of the Danube, it was stipulated that they should preserve the Sulina channel of the river to the depth it was kept during its occupation by the Turks—viz., from 16 to 17 ft.; but this not having been accomplished, the Austrians made a treaty in 1840, which was in force ten years, during which time the Russians were to work continually on the bar, for the express purpose of keeping the bar and channel clear, for which service all Austrian vessels were to pay an extra due. The Russians worked on it two days with hand dredgers, and nothing more was done; the Austrian vessels had, nevertheless, to pay the toll. After considerable correspondence with the English and Russian Governments upon the detrimental effects produced upon shipping by the water being allowed to decrease to about 10 to 8 ft. in depth, it was at last agreed by the Russian Government to construct a dredging vessel in England, which was finally sent out, and set to work in April, 1851, at the Sulina entrance.

The mode of working this machine was such as not to be of the slightest use in improving the channel; it was usually towed out to the bar in the morning; while in operation it was moored bow and stern; the soil was discharged into hopper barges, which were carried down by the current to only about 140 yards distant, and then discharged into the sea; the dredging vessel was brought back into port every evening, and the next morning was again towed out, and the same operation repeated; but such were the defects of the management that no regular channel was maintained; but excavations were made in irregular holes, which increased rather than diminished the existing evils. When the engineer remonstrated he was told to leave it to the proper authorities.

The engineer with the dredging machine continued, notwithstanding, to excavate, &c., ten barge loads per day. The palisade which was constructed by the Turks was destroyed or allowed to decay, and the breadth of the channel was, consequently, considerably increased.

The limited means of keeping the channel clear employed by the Turks, and which enabled them to keep a depth of water from 16 to 17 ft., were in accordance with the usual principles of ablest engineering, which is to give greater force to the current, and thus cause the soil held in suspension to be carried into deep water, instead of being deposited at the entrance of the river.

The principles of improving the entrance of rivers where bars are formed are ably stated in a report on the river Tyne by the late Mr. Rennie, and are:—

"To straighten and confine the channel, and to construct piers at the entrance of the river, in order to increase the effect of the current on the bar, and thus enable the water to act effectually in deepening the channel, and improving the navigation."

These principles have been carried out in many rivers in England and elsewhere with success; it is therefore presumed that if a similar plan was adopted for the Sulina branch of the river Danube, the depth of water would be considerably increased, and the great loss from wrecks on the bar rendered nugatory by the facility of vessels entering the river from deep water.

In order, therefore, to improve the navigation, the following remedies are proposed:—

1st. To straighten and cut off the principal bends of the present circuitous course of the Sulina branch, in those parts between its junction with the main stream at the head of the Delta, at Chetal, to the entrance from the sea, by means of several short canals, amounting together to about eighteen miles in length.

2nd. To cut off the waters which now run through the St. George's branch, by means of an embankment across its channel near Praisnar, and divert them into the Sulina branch, by which means a large volume of water will flow down it, and thus scour out and deepen the channel.

3rd. To carry out to sea, and in deep water, these united channels, by means of two jetties or piers (in a north-easterly direction of one mile in length), each having a distance between them of 450 ft. at the upper end, and increasing gradually to 600 ft. apart at their lower extremities, which should be placed in an angular or bellmouth direction, so as to neutralise the action of the waves in stormy weather, and thus facilitate the entrance and exit of vessels navigating the channel.

From the preceding description and plans it will be seen that the navigation of the Sulina branch of the river Danube will not only be shortened by from seventeen to eighteen miles, and made more direct to Isatchka, but greatly deepened and made easy for the entrance and exit of vessels of larger tonnage, which will be able to navigate the whole distance of the river from its entrance to Isatchka in about half the time, and with less danger and expense than formerly.

As a proof of the losses and inconveniences to which trade has been subjected, it was stated, in a letter addressed to Lord Palmerston, dated September, 1850, from the Vice-Consul at Galatz, that the quantity of grain shipped to Great Britain alone was 210,000 qrs., and that the loss for extra lighterage was £30,000, and that the state of the bar of the Sulina entrance caused a loss to the provinces of £100,000, without reckoning the loss of lives and property by the wrecks and other casualties.

Considering, therefore, the great results which would arise from preserving the free navigation of this most important of rivers from further encroachments, to the prejudice of trade, it is highly desirable, now that the subject is under consideration, that some plan beyond mere assurances should be adopted, so that at least one entrance of the river may be permanently kept open; and, as far as engineering is concerned, the principles proposed are those which have been tried with success, and are extremely applicable to the mouths of the river Danube.

It is stated that the grain from Bessarabia passes down the Sulina branch; and from a letter published by Mr. Charles Cunningham, dated Galatz, 4th April, 1855, the following is stated to be the quantity of grain exported from the Danube in 1852:—

	Imperial Quarters.
From Galatz	614,202
„ Ibraila	1,155,597
„ Bulgaria	200,000
„ Bessarabia	400,000

Holland Street, Blackfriars, May, 1856. G. B. R.

DESCRIPTION OF A NEW CONSTRUCTION OF PUMPING ENGINE.

By WILLIAM FAIRBAIRN, of Manchester.

Paper read at the Institution of Mechanical Engineers, December 19, 1855.
JOHN RAMSBOTTOM, Esq., in the Chair.

IN mining operations the Cornish Pumping Engine has for many years been considered the most eligible for raising water from great depths. In the district of Cornwall, where coal is not one of the native mineral treasures, and where the fuel has, consequently, to be imported for the supply of the numerous engines employed for draining the tin and copper mines, economy in the consumption of the fuel has always been an object of great importance. Owing to the high price of the imported coal, and the, consequently, large item that it forms in the annual charges for steam power, greater attention has been paid to the construction and working of the engines, which has resulted in superior economy; and the Cornish mine-owners have lost no opportunity of affording to the engineer every facility for improvements in the engines and boilers, and at the same time every inducement to those in charge of their management to promote their economical working. The encouragement offered by rewards and premiums has given to the Cornish engine its high character for economy in the consumption of coal; and though in other districts, where coal is cheap and abundant, the same necessity for stringent measures to insure carefulness does not exist, this can be no justification for wasteful expenditure, and neglect of applying the proper means to attain that economy, with which the whole of the steam power in the country ought to be worked. A knowledge of what has been advantageously accomplished in one district is a motive for its introduction into another, and the writer, being convinced of the superior management prevalent in Cornwall, has always advocated the more general adoption of this important system.

When water has to be raised from great depths by steam power, there appears to be no better method of doing so than to use the Cornish engine, working expansively, employing the engine to raise the plungers and pump-rods, the weight of which, as they descend, forces the water up to the surface or next level. This has been for many years the practice in Cornwall, and has been almost invariably accomplished by a powerful engine with its main working beam placed above the cylinder. For such a position, the lever-wall, &c., supporting the beam, is required to be a mass of solid stonework, of considerable height, to resist the shocks to which it is subjected by the sudden descent of the load upon the spring-beams, and which are at times so great in a large engine as to shake the masonry to its foundations. In the engine described in the present paper this objection is avoided, and the expense of high buildings and massive masonry is saved, by substituting for the single main working beam above the cylinder two beams placed below the cylinder, one on each side of the engine, resting upon a platform level with the ground, and in the present instance below the mouth of the pit. The advantage of this construction is, that the whole strain at the bearings of the beams, instead of acting upon the raised tower of the lever-wall, is brought direct upon the solid ground, thereby saving the expense of the masonry above the ground. In case the engine should miss a stroke from an accident in the pit, the shock is received upon a massive oak transverse spring-beam, which passes under the cylinder and rests upon the foundations of the engine-house on each side. A corresponding spring-beam is fixed in the pit to receive the fall of the pump-rods, whenever they happen to pass beyond the limits of the stroke in their descent. This modification in the arrangement has the advantage of making the foundations sustain the weight and shocks of the engine direct, and causes a great saving in the original cost.

The principle of the engine itself presents no material difference from the ordinary construction, and the arrangement is compact, simple, and effective; the engine is worked with double-beat valves, and is so arranged as to cut off the steam at any part of the stroke.

A number of engines on the same plan are now at work, some of them of great power, with from 70 to 80-inch cylinders, and they have given complete satisfaction by their steady, convenient, and economical working.

The engine shown in the Plates lxxv., lxxvi., was erected by the writer in 1851, at the colliery of F. P. D. Astley, Esq., at Dukinfield. It is a single-acting high-pressure expansive and condensing engine, of about 160 H.P. effective, employed to drain a coalpit of large extent. The depth from which the water is raised is at present rather more than 500 yards, but the extreme depth to which it is intended to work will be about 700 yards, when the lower bed of coal is reached.

Fig. 1 shows a longitudinal section of the engine.

Fig. 2 is a transverse section of the engine, and Fig. 3 a section of the valves.

Fig. 4 is a general elevation of the engine to a smaller scale.

Fig. 5 is a general plan, showing the pumping and winding engines, with the boilers and the pit in their relative positions.

The two beams, A A, are carried upon the same frame or bed-plate, B B, as the steam cylinder, C, and each is bolted down to a block of masonry at the level of the floor. The cylinder is 70 in. diameter, and 8 feet stroke; the piston-rod is connected to the beams by a wrought-iron cross-head and cast-iron side rods, as in the ordinary marine engine, a similar parallel motion being used, which in this case is carried by two parallel girders, D D, fixed in the walls of the engine-house, and bolted to the flange of the cylinder. E is the oak spring-beam, 22 in. square, extending transversely under the cylinder, and carried at the ends by the foundations of the building. The ends of the engine-beams strike directly upon the spring-beam, with the intervention only of a block of timber placed upon the spring-beam, with a thickness of india-rubber as a packing to soften the blow. A similar provision is made at the opposite end of the engine-beams to prevent the pump-rods descending too far.

The valves are all on the double-beat construction; the steam-valve, F, is $16\frac{1}{2}$ in. diameter in the seat, and the equilibrium and eduction valves, G and H, are $18\frac{1}{2}$ in. diameter, their motion being regulated by the cataract, I, in the usual manner of the Cornish engines.

The condenser, K, and air-pump, L, are placed in a well below the floor on the opposite side of the centre of the beam; the air-pump is 35 in. diameter, and 4 ft. stroke.

The outer extremities of the beams, A A, overhang the pit at M, where they are attached to the pump-rods by means of a parallel motion, N, (Figs. 3 and 4); the second pair of beams, O O, forming the parallel motion, are fixed one on each side of the pit in recesses, working clear of the pit; they carry at their outer ends a large counterbalance weight, P, consisting of a box filled with cast-iron weights, to counterpoise a portion of the weight of the pump-rods, leaving only sufficient unbalanced weight for raising the water in the pumps.

The pumps consist of six sets of plunger pumps, commencing with one bucket pump at the bottom; they are shown in succession in Figs. 6 to 12.

The main pump-rod, R, has a stroke of 8 ft., and is 15 in. square at the top, being attached by a wrought-iron strap to the cross-head of the parallel motion, N.

The first four pumps (Figs. 6, 7, 8, and 9) are all of the same size, with 12-inch plungers, and 12-inch rising main; the pump-rod, R, diminishes in size from 15 in. square at top to 11 in. square at the fourth pump down, and 8 in. square at the two lowest plunger pumps, and each of the plungers is attached to it by a timber block and iron straps.

The two lowest plunger pumps (Figs. 10 and 11) are of similar construction and dimensions, except that they are smaller in diameter—the plungers being only 8 in. diameter, and the rising main 8 in.; the difference is made in consequence of a portion of the water entering from a higher level of the workings into the cistern of the fourth pump, Fig. 9.

The bottom pump (Fig. 12) is a bucket and plunger pump, raising the water at both strokes of the pump-rod. The barrel of the pump is 8 in. diameter, and the pump-rod 5 in. square, being half the area of the barrel, so that half the water is raised at each stroke.

Figs. 13 and 14 show the detailed construction of the top pump, drawn to a larger scale. The suction and delivery valves are leather flap valves, with two semi-circular openings.

Each pump has the same lift, and raises the water 200 feet, delivering it into the cistern from which the succeeding pump draws. The engine makes about 13 strokes per minute, and the quantity of water raised is, consequently, 500 gallons per minute, being equivalent to about 160 H.P. effective.

The pumps and pit-work have been arranged with a view to saving room, and, at the same time, affording facility for repairs, and convenient access to the valves and buckets of each of the sets into which the pumps are divided. The entire space occupied by the six sets of plunger pumps, and one bucket pump, is only about one-fifth of the area of the shaft, which is 12 feet in diameter; and the shaft not only contains the pumps to a depth of 1,500 feet, but also has space enough for the ascent and descent of two sets of boxes, each box containing about 8 cwt. of coal. A description of the large Winding Engine, used to raise the coal in this pit, was laid before the Institution at a former meeting (see Proceedings Inst. M. E., December, 1853); and the position of the engine is shown at S, in the general plan, Fig. 5.

The Chairman observed that the arrangement appeared more judicious than the old plan of the beam at top, as the engine was more compact, and the principal strains and shocks were brought directly to the level of the ground, without the intervention of walls or columns.

Mr. Beyer had seen the engine at work, and thought it one of the finest pumping engines he had seen; it was well executed, and appeared to work well; the engine and pumps were conveniently arranged for access, and the fixing of the beams was solid and simple; he thought the arrangement would be found to be generally preferable.

Mr. Siemens inquired what was the extent of expansion in the engine, and the pressure of steam employed. He thought that the principle of expansion was not yet carried to its utmost practicable limits, although these limits were approached; but science had already pointed out the way which would lead without fail to a further great improvement of the steam-engine.

Mr. Neale replied that the steam pressure was about 15 lbs. per inch, and it was cut off at about 1-5th of the stroke; there were five or six boilers in use, cylindrical double-flue boilers, 7 ft. diameter, and 27 feet long, with flat ends and gusset stays, the internal flues being 2 ft. 8 in. diameter.

The Chairman then proposed a vote of thanks to Mr. Fairbairn for his communication, which was passed.

ON THE PROGRESSIVE CONSTRUCTION OF THE SUNDERLAND DOCKS.

By Mr. John Murray, M. Inst. C.E.

Abstract of paper read at the Institution of Civil Engineers, May 6, 1856.

Robert Stephenson, Esq., M.P., President, in the Chair.

The very considerable shipping trade of the port of Sunderland had hitherto been conducted entirely in the tideway of the river Wear, which, even after all the successive improvements of the channel, only afforded 60 acres of water surface, reduced at low water to about 40 acres, much contracted by the shipping. Nearly all the vessels took the ground when the tide was out, and were liable to be strained, whilst during floods, especially when floating ice was coming down, they were frequently severely injured. The evident remedy for this condition was the construction of docks, for which many designs were submitted by eminent engineers, but nothing was executed until 1838, when a dock of about 6 acres, with a tidal harbour of 1 acre, was constructed on the north side of the river, by Mr. Brunel, for a company. The principal collieries being, however, situated on the south side of the Wear, and the great mass of the inhabitants being located there, it was necessary to have some adequate accommodation for the trade, which was being attracted to other ports offering greater facilities and more safety for the shipping. Parliamentary powers were, therefore, obtained in 1846 for the construction of docks on the south side by a company, of which Mr. G. Hudson, M.P., was the Chairman, in accordance with the designs of Mr. John Murray, the author, who had for many years directed the consecutive improvements of the river Wear and the works at the mouth of the harbour.

The site selected for the docks was a ledge of rough rocks, situated on the sea shore, between the south pier and Hendon Bay. According to the Parliamentary plan the northern basin was proposed to communicate with the river Wear by two passages of 45 ft. and 80 ft. in width, with an area of 2½ acres. This was connected, by two locks of 45 ft. and 60 ft. in width, with the wet dock of 27½ acres, which, again, had two similar lock openings at the southern extremity into a half-tide basin of 4 acres, connected with a tidal harbour protected by rubble stone breakwaters in Hendon Bay, so as to permit vessels to get direct to sea without passing into the river Wear. The contemplated total water area was about 47 acres.

The staple business of the port being the shipment of coals, of which about 1,500,000 tons were brought to Sunderland in 1846, every facility was provided by timber staiths for the colliers when loading at their berths; and the dock being designed for this class of shipping was, for economy, to have the sides sloping, and pitched with rubble stone.

Great doubts were entertained as to the practicability of this project, which certainly did apparently offer considerable difficulties—in constructing groynes which would maintain a barrier of beach or shingle sufficient to check the inroads of the sea—in keeping down the water during the execution of the works—and in retaining it in the dock after its completion. The two latter objections were replied to by showing what had been done at the north side dock; but the first still remained doubtful. In order to settle the point it was decided to erect three groynes at the northern end, and if they produced the effect of causing a deposit of sand between them by the waves in their travel from north to south, it was considered that when the groynes were connected by the excavated material from the dock, a consolidated embankment would be formed, impervious to water from the sea, by the sand being washed into the interstices, and capable of retaining the water in the dock. The result was perfectly conclusive, as long before the completion of the groynes, in 1847, a considerable deposit of sand had been effected. Subsequently a half-tide basin was formed at the northern end, and, in accordance with suggestions made by Mr. Rendel, the quay in front of the tidal basin was entirely removed, so as to leave the whole width open to the river.

By means of an embankment the head of groyne No. 2 was connected with the adjacent high ground, and the material from the excavations, &c., being deposited, an area was reclaimed from the sea, which allowed the work to be executed by regular day work, instead of being performed in the intervals of the tides.

It was then determined to construct the dock for general commercial purposes, as well as for the shipment of coals, by substituting vertical walls for the slopes, to increase the depth to 24 ft. below high water of ordinary spring tides, and to lay the cills of the entrances at 20 ft. 6 in. below such tides, so that the gates might be opened for the admission and departure of vessels for two hours before and after high water without lockage.

As soon as the contract was let to Messrs. Craven, steam-engines were erected for pumping, &c., and means were established for hauling away the excavated marly rock for depositing between the groynes, &c.; a timber barrier or dam was soon after formed, stretching from the table land of the Town Moor to the head of groyne No. 3; and clay from the excavations was deposited against it, and it was ultimately united with the barrier embankment, by which means the tide was excluded from the site of the northern portion of the great dock. Groynes Nos. 4 and 5 were completed in August and October, 1847, and the first stone of the half-tide basin was laid on the 4th of February, 1848.

In order to insure uniformity and goodness of quality in the mortar employed, an establishment was created by the Dock Company for burning and grinding the blue lias limestone and pozzuolana and mixing the mortar, for sale to the contractors.

Whilst the filling up between the groynes was proceeding a barrier of timber uprights, with raking shores and planking, backed with clay, was run out from the cliff of the Town Moor to join the head of groyne No. 5; and thus the second area of the great dock was reclaimed from the sea. Groynes Nos. 4 and 5 having been previously connected by deposited material, groynes Nos. 6 and 7 were completed in 1848.

Another barrier of timber was in the mean while formed at the southern end from the high ground to the head of No. 7 groyne; and thus, before the end of 1848, the tide was excluded from the entire area of the great dock. The rock was then excavated to the full depth, and a coffer dam was placed across the end in order to permit it to be lengthened at any subsequent period without disturbing the shipping in the dock.

The groynes served to maintain the whole embankment between the south pier and groyne No. 7, a length of 1,120 ft., at a cost of £13 per lineal yard of coast—a much cheaper rate than any sea-wall or glacis could have been executed for, and the success was perfect.

These groynes had been so fully described by Mr. W. Brown (Assoc. Inst. C.E.) in his paper on them, read to the Institution in 1849, that they were merely mentioned in the present paper. They were generally constructed of rubble stone hearting, and the bed and coating of freestone laid in pozzuolana mortar, the joints being stopped with the best Roman cement. The total cost of the seven groynes, varying from 210 ft. to 360 ft., with slopes from 1 in 18 to 1 in 32, situated at distances of 350 ft. to 450 ft. apart, was £14,480, or £19 16s. 3d. per lineal yard of groyne.

At the termination of Messrs. Craven's contract there was available for commercial purposes an area of 12 acres of embankment, exclusive of the quay, &c. For a long time one pumping engine of 30 H.P. sufficed to keep dry the whole area of the works. Another engine of 35 H.P. was subsequently added in case of accident, but no difficulty was experienced in keeping the water down.

A series of jetties were projected from the western quay in such a manner that the vessels overlying each other could be loaded with great facility. Four vessels could, therefore, be accommodated in the space usually devoted to one ship. Fifteen coal-shipping drops were also erected, and the railways so arranged as that the loaded waggons ran by their own gravity to be discharged, and when emptied returned, also by their own gravity, on other lines of railway, to the standing places appropriated for them.

The dock gates, constructed by Messrs. Hawkes, Crawshay, and Co., were composed of cast-iron framework, lined and covered with teak planking.

The next operation was the removal of a large shelf of rock situated in the river, immediately opposite the front of the tidal harbour. This was effected by means of a coffer-dam, which enabled the rock to be excavated to a depth of 4 ft. below the gate-cills, or an entire depth of 10 ft. below low water of ordinary spring tides.

These proceedings enabled a wet dock of 18½ acres, a half-tide basin of 2½ acres, and a tidal harbour of 2½ acres, connected with the river Wear, to be opened for commerce in June, 1850, and the other portions of the design were then immediately thought of seriously, as the facilities already afforded produced an increase of trade, and caused the port to be frequented by larger vessels. It thus became imperative to execute the original design of having an opening directly to the sea, without going into the river at all. A comprehensive design was, therefore, made, and a new series of groynes, Nos. 6, 7, and 8, were commenced in 1850, and groynes Nos. 2 and 3 were reconstructed in positions to suit the extended works,—thus reclaimiug an area of very valuable land.

The excavation of the southern half-tide basin, the building of its walls, with the outer and inner entrances, and the construction of the eastern pier, were proceeded with; great part of the latter being executed by means of the diving bell and diving dress. A timbered structure was then commenced from the embankment towards the south pier; the piles were connected by planking, protected by clay and rubble stone. The pier head was in this manner attained, and it was ultimately intended to raise it with rubble stone to the level of high water of spring tides.

The channel coffer-dams were commenced in the spring of 1853, and in December following the old dam in front of the outer entrance was removed, and the excavation of the rock in the channel was vigorously prosecuted, the material being drawn up inclines of 1 in 6½ by a locomotive engine, running upon the level ground at the top of the embankment. This was found to be cheaper than using a fixed engine.

A second coffer-dam was formed in skeleton to the east or seaward of No. 1 dam for its protection. It was closed in August, 1854, and was in like manner protected by the coffer-dam No. 3, in skeleton, which last was completed in June, 1855. These precautions were necessary, as the dams were so exposed to the action of heavy seas, and so near to the brink of deep water.

Upwards of 124,000 cubic yards of marly rock and other materials were excavated from the channel without the sea ever making a breach in these coffer-dams, or any interruption of the work occurring, although the channel was excavated throughout its entire length to a depth of 12 ft. below low water of spring tides. The width at the top, near the outer entrance, was 240 feet, and at the seaward end 107 feet; the sectional area being reduced in order to keep up the force of the current from the sluices, by the aid of which it was intended that the channel should be freed from any deposit of sand or other material. Dredging would have been an expensive system, and not to be depended upon in so exposed a situation; therefore, scouring was resorted to as the most effective method in such a depth as 12 ft. below low water of spring tides. After careful examination of all the best examples of sluicing both abroad and at home, the author devised a series of eight main scouring conduits, each 9 ft. high and 7 ft. wide, having a combined area of 504 square ft.; they were situated four on each side of the entrance, and were closed by shuttles, which could all be severally or simultaneously opened and shut by the same hydraulic power as was applied by Messrs. Armstrong and Co. for working the gates, bridges, and other machinery of the docks. A discharge was calculated on from 34 acres of water, 4 ft. 6 in. in depth, and assuming that quantity of water to be discharged from the eight sluices in fifteen minutes at the period of low water of spring tides, properly proportioning the area of the sluices and contracting the seaward mouth of the channel, it was presumed that by heaping up the water in mid-channel without any means of lateral escape, an altitude would be attained which would generate a sufficient velocity to produce great scouring effect to a considerable distance. Beyond the pier-head the depth of water was great, and no injurious deposit could take place there, as the littoral currents would carry everything away.

The mean velocity of the issuing water was 6 ft. per second, which would be reduced at the pier-heads, 350 yards from the sluices, to 3 miles per hour at the bottom of the channel. This current was evidently sufficient to carry away all deposit, and yet would not injure the bottom, which, at the outlets of the conducts, was pitched for some distance with large blocks of rubble stone set in pozzuolana mortar.

The trade of Sunderland has always been seriously inconvenienced by the undue retention of vessels in the river Wear during certain winds and at certain times of the tide, as there was not sufficient water on the bar to enable heavily laden vessels to enter or to leave the port, except at spring tides. The southern outlet of the dock was intended to remedy this inconvenience, and at present the largest vessels could put to sea without passing into the river, and thus could entirely avoid the bar. In fact, loaded vessels could enter or leave the dock during 20 hours out of the 24 hours, and vessels in ballast could pass in or out even at dead low water. From fifty to eighty vessels could be locked through during each tide, and as many as from eighty to one hundred could be passed by steam-tugs before the ordinary closing of the gates.

The gates, which were of cast-iron covered with teak planking, were 60 ft. wide between the hollow quoins,—they could be opened or shut in about two minutes by the hydraulic power derived from a pumping-engine of 30 H.P., which forced the water into an accumulator, whence it was conducted to the various rams, under a pressure of a column of 900 ft. in height.

Provision was made by the disposition and form of the piers for sheltering the entrance from the anticipated violence of the waves at the sea outlet, and the precautions taken were very effectual in preventing any excessive agitation within the channel.

A description was then given of the works connected with the southern extension of the dock. Two of the five groynes had been constructed by Mr. W. H. Brown. An excavation of 13½ acres, surrounded by walls, had been added to the great dock; but the remaining three groynes and the timber pond of about 10 acres were not yet completed. In the progress of these works it was necessary to remove the dock coffer-dam, and to execute several other somewhat hazardous works, which were, however, performed with perfect success.

A graving dock was now in course of construction at the northern end, communicating with the tidal harbour and the river. The width between the hollow quoins would be 45 ft., the length 345 ft., with a width at the bottom of 25 ft. 8 in., and at the top of 64 ft. This would complete the works, as far as at present projected, at a cost of £650,000, and afford an area of water surface of upwards of 66 acres, and an area of quays, &c., of 80 acres, in obtaining which about 127 acres were reclaimed from the North Sea. The depth of water in the dock at ordinary spring tides was 24 ft., and the total quay space in the great dock was 7,622 ft., with fifteen self-acting coal drops completed, and ten more to be added hereafter.

A tabular statement of the general particulars of areas, depths of water, rise and times of tides, and of prevalent winds, &c., completed the paper.

May 13, 1856.

The evening was entirely devoted to the discussion of Mr. Murray's Paper "On the Progressive Construction of the Sunderland Docks."

In commencing the discussion it was suggested that more information should be given as to those parts of the work which presented the largest amount of novelty, or which had required the greatest exercise of skill in their execution. The site of the docks was very peculiar, inasmuch as they had been constructed on ground gained from the sea by the action of groynes projected from the shore. There had been, originally, much doubt as to the feasibility of that plan or mode of proceeding; it had, however, proved very successful.

The dams employed were novel in construction,—apparently cheaper than usual,—and had been used with success in exposed positions. There had occurred some casualties with one of these dams, which were most ingeniously met, and would be interesting features in the paper if added before publication.

All the harbours on the north-east coast suffered more or less from the formation of bars across the mouths of the harbours themselves, or of the rivers leading to them; the difficulties in keeping open the channels were considerable, and the scouring power hitherto employed had not been very successful; the system used at Sunderland appeared to be better devised, and the results were stated to be superior to anything attained elsewhere; it would be very desirable to be well informed on all these particulars.

It was explained that the author had refrained from noticing the groynes very particularly, because their construction had been minutely described in the paper already presented to the Institution by Mr. W. Brown (Assoc. Inst. C.E.). The effect produced by the three southern groynes, placed seaward of those originally constructed, had been to collect a mass of sand and *débris* on their southern sides; whilst the old groynes at the northern end of the embankment collected the sand on their northern sides. This apparent anomaly was due to the action of the littoral currents, which set sooner into Hendon Bay than at the mouth of the harbour, in consequence of the tidal wave having a more rapid progress in the deep water of the offing than along the shallow water of the coast. In consequence of this there was a counter-current northwards from Hendon Bay, and similar counter-currents existed both north and south of the mouth of the harbour, caused by the projection of the piers. A point had been observed, between the northern and southern groynes, where there was a junction of these tidal currents, indicated by a spit of sand and gravel.

Until Hendon Bay was reclaimed and converted into dry land, this heaping up of the *débris* would occur on the southern side of the south groynes, and the indraught of tide into the mouth of the harbour would produce a like effect on the northern side of the north groynes. The construction of the intermediate groynes had been delayed by want of funds, but there was little doubt of a uniform and permanent line of shore being formed when they were run out.

The coffer-dam in the tide-way of the river enclosed 2½ acres within it; there was considerable difficulty in obtaining a secure footing for the main piles, but after a deposit of clay had been made the object was effected, and being secured together by walings and bolts, the dam proved quite watertight. A series of raking shores inside gave great solidity to the structure, and enabled the rock to be excavated close up to the inner piles.

The sea coffer-dams of the channel were, however, of a different construction;—the object being to protect the inner dam by another in front of it, in skeleton, secured by a deposit of clay brought up to the low water mark. The inner dam had then a mass of clay deposited on the interior side, having a tendency to force it outwards, but this effect was prevented by a series of raking shores. This pressure had the desired effect of keeping all in place, although powerfully acted upon by the waves of the sea. On more than one occasion it had been found necessary, during raging storms, to add extra weight to the dam, by bringing waggons heavily loaded with rubble stone, along the railway, to the centre part. The effect of this additional weight was to impart greater stability to the structure, even when the waves were lashing against the timbers with considerable violence.

The average cost of the three channel coffer-dams, for timber, iron, and labour in fixing, and for depositing the clay, amounted to £19 3s. per lineal yard; and deducting from that sum the value of the timber which had been used in other portions of the work, the actual cost had been £16 12s. per lineal yard of coffer-dam, exclusive of the expense of rooting out the timbers and removing the clay. When compared with coffer-dams of the usual construction, even in situations not exposed, as these were, to the action of the sea, the cost was very moderate.

The scouring conduits were supplied by water from the half-tide basin, through archways, into a well 40 ft. long, on each side of the shipping entrance. The four entering ports from each well were closed by shuttles, having the cills all laid at one level of 23 ft. below the datum, or 8 ft. 6 in. under low water of ordinary spring tides.

Each entrance was 7 ft. wide by 9 ft. high, and the conduits were separated into two, for a short distance within the discharging ports.

	Under low water of spring tides. Ft.	in.
The first pair adjacent to, and on either side of the shipping entrance, had their bottoms laid at the depth of	12	0
The second pair beyond on each side	9	4
The third pair „ „	7	4
The fourth pair „ „	5	4

The sectional areas of the last-mentioned pairs were about 10 per cent. less than the sectional area of the entering ports, being each .... 7 ft. 0 in. wide by 4 ft. high.

The sectional areas of the first-mentioned pairs were about 20 per cent. less than the entering ports, being each................ 6 ft. 9 in. wide by 4 ft. high.

The sectional areas of the intermediate pairs were proportioned in like manner, with the intention of keeping up the force of the currents; and in plan the conduits had the form of a fan, for the purpose of conducting the issuing water into the centre of the channel.

The area of the great dock, with the southern half-tide basin, was taken at 34 acres, = 1,481,040 superficial ft.

The scouring water, at an ordinary spring tide, might be lowered to the permanent level in the dock, being a depth of 4 ft. 6 in.

Hence 1,481,040 × 4·5 = 6,664,680 cubic ft. of water available for scouring.

Eight apertures, each 7 ft. wide by 9 ft. high	504 sq. ft.
Deduct 10 per cent. for friction through the conduits	50 „
Gave as available area for scouring water	454 sq. ft.

	Ft.	in.
Then the rise of an ordinary spring tide	14	6
Deduct for rise of tail-water	1	0
	13	6
The mean depth 4 ft. 6 in. ÷ 2	2	3
Leaving mean pressure	11	3

which was calculated to produce a velocity of 862·44 ft. per minute.

Then 862·44 × 454 = 391,548 cubic ft. per minute,

and $\frac{6,664,680}{391,548}$ = 17 minutes.

2 minutes consumed in opening the shuttles.

Leaving 15 minutes available time for scouring.

Assuming $\frac{6,664,680}{15}$ = 444,312 cubic ft. per minute, which, passing through the sectional area of the channel, on the inner side of the pier heads, = 1,232 sq. ft.

$\frac{444,312}{1,232}$ { = 360 feet per minute, = 4·091 miles per hour for the mean current, = 3·166 miles per hour along the bottom,

which was a current capable of carrying along large shingle and broken stones.

The effect of an experimental trial had been most conclusive. Although a large quantity of clay remained in the channel of the outer coffer-dam, standing at the height of 6 ft. above the bottom, and consequently holding the water within it in a quiescent state, yet, when the shuttles were drawn, although there was a depth of 16 ft. of water in the channel, or 4 ft. above low water of spring tides, and the pressure of the water in the docks only 10 ft., and when closed was reduced to 7 ft., the column of issuing water caused that in the channel to be heaped up, and being prevented by the channel cut through the marly rock from escaping laterally, the whole mass of fluid was set in motion like a river. Meeting with the resistance of the clay in the outer coffer-dam, it rose and fell over it, as a tumbling bay; and even then the course to seaward was strongly visible on the surface for a distance of more than 2,000 ft. beyond the pier-heads.

It was stated that Mr. Murray might be congratulated on having carried out a system of sluicing which promised to be useful in important cases. Now that the size of vessels was so much increasing, the maintenance of deep entrances to harbours and docks became a question of the greatest interest. It was argued that a marked distinction should be drawn between the operation ordinarily miscalled sluicing, or scouring, and the much more effective principle applied in this case. In the former, the object was to direct a small stream of water, with a high velocity, directly upon the spot to be scoured, and though this was usually effective in removing deposit from one particular place, it only carried it a short distance away, to be soon again deposited; and hence, as at Dover and many other places, this system of scouring had, from its inefficiency, fallen into disrepute. The process, however, adopted at Sunderland was on a different principle—namely, to create what might be called a temporary artificial river, which, running in a well defined channel for a certain time at low water, should not only scour or clear the bed of such channel from deposit, but should carry that deposit away to a considerable distance. The velocity with which this scouring stream should run could be perfectly regulated by the sluices, the only object of which became, in this case, to supply such a quantity of water into the channel as would impart and maintain the velocity required; they, therefore, should be so placed as to distribute the supply widely, and thus to insure an equable stream in the channel. It was considered important that the channel should become gradually narrower towards the mouth, so that the stream might act with the greatest power on the part where the deposit was most likely to occur. Confident expectations were held out that by the more general application, under suitable regulations, of this system of sluicing, deep entrances might be efficiently and economically maintained in situations where they would otherwise have been impracticable.

It was very desirable, in the discussion of the subject, to avoid confusion of terms, which so often led to apparent diversity of opinions on the part of those who ought to agree upon such a question as that of the well-known effects of a scour of water. Unfortunately, the terms "sluicing and" "scouring" had been indiscriminately applied to the operation of merely stirring up and producing a commotion in a body of water, at any one place, by the violent action of a jet of water directed on a limited surface, and the operation of a regular continuous stream, capable of holding in suspension and carrying away the matter set in motion by it. The former was a very common application of water-power in English work; the latter had not, hitherto, been applied so frequently as on the Continent.

The effects were totally different, and ought not to be confounded. A violent jet of water applied to one spot was quite useless as a scour, unless the quantity of water ejected was sufficient to produce a regular current over the bottom surface, or within the channel to be scoured, and was also sufficient to take up and to sweep away the deposits on that bottom surface.

A very moderate current would suffice to produce this effect in nearly all those cases in which engineers would be most interested. A velocity of two or three miles per hour would remove coarse gravel, and even less was sufficient to carry away any deposit consisting of finer particles; but in such a case the current must be as uniform as possible.

An average velocity would not suffice, if it was an average of a violent commotion at one part and a low velocity at others; this might even be, and generally was, mischievous, instead of beneficial, and such an action must not be called "scouring"—it was merely stirring up; and from this confusion of terms there no doubt arose those contradictory opinions as to the probable effects of various proposed works, which were called, without distinction, "scouring" or "sluicing."

Where a sufficient quantity of water was caused to flow through a defined channel, as had been proposed by Mr. Rendel at Birkenhead, or as had been so judiciously adopted by Mr. Murray at Sunderland, the effect must be such as had been described in the paper; and it was very gratifying to see the well-known action observed in natural channels, such as rivers, which maintained their own uniform depth, so successfully imitated in artificial works.

It might also be observed in natural outlets, or by small experimental apparatus, that a column of water discharged with a uniform and moderate velocity into an open basin continued its course in a direct line, and produced a scour to a much greater distance than the same quantity of water would do when tumbling in, or boiling out, from an aperture, and producing a great local commotion, the power of which was soon dispersed, and was, therefore, expended without producing that effect which was generally desired. A long channel might be thus cleared, and the effects carried out some distance into the larger basin, whether of a river or the sea; while a short channel, immediately acted upon by sluices, would not be so effectually cleansed, and no effect would be produced beyond the mouth. The great object should be to obtain a uniform velocity over the whole sectional area of the channel; the arrangements made by Mr. Murray appeared admirably adapted to insure this, and the results he had described confirmed the opinion.

The peculiar quality of the magnesian limestone excavated was commented upon; it was almost as soft as chalk whilst *in situ*, but hardened very rapidly on exposure to the air; it stood almost vertically in the excavations, and greatly facilitated the execution of the works.

This was nearly, if not quite, the first time that a harbour had been constructed with the intention of eluding an existing bar at the mouth of the river, which was the natural outlet; and it was a principle which, where practicable, would be advantageously followed by engineers, instead of incurring the expense of improving the outfall of the rivers and keeping the mouths open by dredging. The systems of scouring at the harbours of Dunkerque, Ostend, and Boulogne, were mentioned, and succinctly explained. The effect there obtained was to render available, for good sized vessels, ports which otherwise would soon be entirely blocked up, like the former harbour of Ambleteuse, where a fishing-boat could now scarcely enter. The object to be attained by sluicing, was not only to scour away the deposit in the channel or entrance to the harbour, but to prevent a bar being formed, by the accumulation of that deposit, at a short distance from the mouth of the harbour; this could only be effected by setting simultaneously in motion, and keeping up the velocity of, a large body of water, which would carry the deposit far out to the sea depths. The sluices at Boulogne, constructed by Vauban, not being sufficiently large, did not efficiently perform this duty, and hence the necessity for such long piers for the entrance, and for the further extension of them, now very wisely contemplated, to meet the demands of the traffic through that port.

It was urged that one view of the case, not hitherto brought forward, was the manner of introducing the deposit which was required to be removed. Now, water entering a harbour, into which there was not any considerable indraught, had not any great veloeity, and the amount of matter carried in was only that due to that particular velocity. If a greater velocity was imparted to the outpouring than to the ingoing stream, any material so brought in would be partially carried out again by the ebb tide, and the rest would be cleared away by the action of sluieing; always provided, that a uniform velocity was imparted to the entire mass of water in the ehannel, which could only be done by arrangements somewhat similar to those described in the paper.

If water was projected downwards at an angle, it was refleeted, and the momentum was lost on the bottom; if it could be discharged through sluices of the same section as the harbour itself, and at the same velocity as it was required to travel throughout the distance, a uniform velocity would be obtained; but as this was not practicable, advantage must be taken of the equality of pressure; and to insure this at the extreme point, the orifices might be made narrower, so that the pressure, as applied from the sluices, would be brought to bear, and would cause the whole mass of water to move at one uniform velocity in the channel.

With reference to the utter failure of action of water when projected at an angle, it must be borne in mind that fluids followed the same law as solids—as regarded the rectilinear motion; any rectilinear motion given to the whole mass would be preserved, and thus the beneficial effect of a uniform scour in removing on the efflux, or outdraught, whatever deposit had been brought in on the influx, or indraught, at a less velocity, would be secured.

It was agreed that it would be advantageous, if possible, to select, as sites for harbours, positions where there was neither littoral travel of shingle, nor deposit of silt or sand; but where were such positions to be found? Exception was taken as to the statement of the deposit occurring on the slow indraught of the flood tide, and being washed out again by the scour, when practised on the ebb tide. That condition would apply to Birkenhead, but not at all to Dover. The travel of the shingle might be stopped for a time by groynes, or piers, but it was only a matter of time, and when the depths into whieh the shingle had been directed were filled up, the former state of things would be again observed.

It would appear that the groynes at Sunderland had been placed and constructed with great judgment, as the aceretion of land had been steady and permanent. The time, however, would arrive when, having done their work, they would cause the sluicing power to be necessarily called into play to prevent the formation of a bar beyond the piers, unless there was a great depth of water at that spot.

The travel of shingle was due to the action of winds and tides, and would continue under any circumstances, although the direction of the travel might be changed, for a time, by artificial barriers.

The great problem in sluicing was the maintenance of a strong uniform current; the sluice apertures must necessarily be under pressure, and the issue of water must be so contrived as not to tear up the bottom, while the power so brought to bear against the tail-water must be such as to set it all in motion in a mass, imparting a suffieient velocity to it to carry away all deposit, and convey it far out to sea. For this end, the various heights of the cills of the sluiees at Sunderland were well intended, as all parts of the mass of water were acted upon simultaneously, and pressed onwards in a mass, instead of allowing the upper stratum of water to eurl back, as was the ease when the cills were all at the lowest depth.

THE GRAVING ESTABLISHMENTS OF PORT JACKSON.

From the "Sydney Morning Herald," December 26th, 1855.

(Continued from page 114.)

We now continue the deseription of the works *already completed* on Cockatoo Island:—

Two 20 H.P. condensing-engines have been erected for the purpose of working the pumps for emptying the dock; and at the same time giving motion to the shafting for driving the machinery in the line of workshops. They are on the direct-acting principle, with cylinders 24½ in. in diameter, the piston-rods working on the same crank-shaft, and being continued through the bottom of the cylinders, and working a pair of double-action 19 in. pumps, which are fixed in the well immediately under the engines, without the aid of beams, bell-cranks, &c. They are fitted with the necessary apparatus for working steam expansively, the steam being supplied by two large cylindrical boilers adjoining the engine-house. The valves and condensers are all of the most improved deseription.

The engines will make about twenty-six revolutions per minute, causing the pumps to discharge about 400 cubic ft. of water in the same time. The fly-wheel, weighing 5 tons, is in two pieces, and fixed to the crank-shaft, by means of keys and wrought-iron collars "shrank off." The total weight of these engines is about 40 tons, and they are from the well-known house of Messrs. Rennie. The boilers are 22 ft. long, and 6 ft. in diameter; and a flue conveys the products of combustion from the fires, underground, to a eireular chimney-shaft, 80 ft. in height, built of brick, upon a square base, and with stone eap and plinth.

The eaisson is eonstructed of sheet-iron, from 9·16 in. to ¼ in. in thickness. The beams are of angle-iron, with two 18-in. sluices, and the neeessary pumps for discharging it of water. The wooden keel and stern-pieces are firmly bolted to the caisson, which will be ballasted with pig-iron.

We may observe, that this caisson is from the manufactory of Messrs. Mare and Co., of Blackwall, who construeted the caisson for the South Inlet Dock at Portsmouth, already referred to. It came out here in pieces, and has been put together in the dock, 25,000 rivets having been employed in the work. It is now eompletely ready for floating.

A tide drain has been constructed to assist the engines in the discharge of the dock, the tide having a fall of 5 ft.

A tunnel, 6 ft. in height and 4 ft. in width, for eonveying the water from the dock to the engine well, has been cut through hard shale. Its length is 250 ft., and its lining with brick and cement is rapidly proceeding with. In this tunnel is fixed a large cast-iron sluice, manufaetured at the foundry of Messrs. P. N. Russell and Co., of Sydney.

The water, after being pumped up by the engines, is eonveyed into the harbour by means of a eulvert.

The greater portion of the lime which has been used upon these extensive works was brought from Norfolk Island, and is of a very superior quality. It is procurable in large quantities at that *locale.* From New California and from Portland quantities of excellent lime have also been brought, and used at the doek. Roman cement has likewise been abundantly employed. All the lime has been burnt on the island, for which purpose two large kilns have been built.

In quarrying the large blocks of stone blasting has not been adopted, owing to that proeess being liable to shake and destroy the stone, but a series of holes are made in the rock by means of "jumpers," and they are then wedged open.

With respect to the line of workshops (an important feature in the general design) we may state that its elevation, in its total length, will be 300 ft. Two large divisions in the centre, 100 ft. by 40 ft., will contain the lathes and other accessories for the construction of machinery, and at either end will be the engine and boiler houses and offiees. At the rear of the building it is in contemplation to ereet a foundry; the whole being conneeted with the dock by means of tramways. The interior of the workshops will have an overhead travelling-crane, running the entire length of the building. Each of the two eentre workshops will be lighted by twelve large circular-top windows.

In the temporary workshops, where active operations are now progressing, we see a small engine of 6 H.P. serving to keep the dock clear of water during the excavation, and, at the same time, driving a large and small lathe, and a very fine punching and shearing machine. The lathes are from the works of Messrs. Whitforth and Sons; the punching and sheariug maehine from Messrs. Fairbairn and Co. (both Manchester firms).

There are also smithies, a small brass foundry, and earpenters' shops, in full work. Varieties of valuable tools have been and continue to be manufactured in the various workshops, so that whatever may be the design of the Government with respect to the disposal of the dock when completed, every requisite for earrying out the most extensive arrangements will be found immediately available, whether they refer to the dock or the doekyard. Already, we may observe, many works peculiar to such an establishment have been performed at the Fitz Roy Dock; as, for example, the repairs of H.M.S. *Fantome* and *Acheron*, the manufacture of blocks for the *Middle Head*, 16 gun carriage wheels, &c.

To Captain K. Gother Mann and to Mr. James Henry Thomas (the latter officer having prepared the designs for the whole of the extensive plant of machinery, and for the additional buildings, &c., now in course of completion), the highest credit must be given, not only for the ability displayed by them in earrying out so important a work, but for the tact they have displayed in overcoming those obstacles which will ever be met with when foreed labour, and that, in most respects, of the worst kind, is employed.

ON THE JUNCTION OF THE ATLANTIC AND PACIFIC OCEANS, AND THE PRACTICABILITY OF A SHIP CANAL, WITHOUT LOCKS, BY THE VALLEY OF THE ATRATO.

By Mr. F. M. Kelley, U.S. (America.)

Abstract of paper read at the Institution of Civil Engineers, April 22, 1856.

John Hawkshaw, Esq., Vice-President, in the Chair.

It was stated that the eonsideration of this subject had become urgent, and the adoption of some definite plan indispensable, in eonsequence of the commercial activity which had resulted from the discovery of gold in California and in Australia, and the rapid development of trade throughout the whole of the Pacific. But the very extension of trade had introduced new elements into the problem: the larger dimensions now given to ships, and the inereasing value of time, rendered it necessary that the proposed eommunication should be of a suffieient width and depth to permit the passage of the largest class of vessels, and that it should, if possible, be constructed without locks, so as to insure economy of time as well as of distance. It then gave a brief review of the different routes hitherto proposed, and the objections to which they were open.

The Tehuantepec route would require 150 locks; even then it would be 210 miles in length, and great improvements would be necessary in the harbours at both ends. The very unsettled state of the government in Mexico rendered this undertaking most hazardous at the present time.

The Honduras route, 160 miles in length, was open to the same objection as to locks; the summit level was very high, 2,681 ft. above the sea; and, moreover, sufficient water could not be obtained for the number of locks required.

The Nicaragua route, 194 miles in length, would have twenty-eight locks; the river of San Juan would require to be deepened throughout; 47 miles of additional canal must be made; great improvements must be effected in the harbour of Greytown, and a new harbour altogether constructed on the Pacific. The modification of this project, by which the port of Realeja would be the terminus on the Pacific, would increase the distance above 100 miles, and require great additional lockage, which, it was very doubtful, whether the Lake Leon could supply.

The Chiriqui route was considered utterly impracticable by M. Hellert, who found that the supposed passage through the mountains offered the most formidable difficulties.

The Panama route would require thirty-six locks and six aqueducts, and the approaches on either side would demand vast alterations to adapt them to the present wants of commerce.

The San Blas, or Mandingo Bay route, had never been sufficiently explored, on account of the decided hostility of the Indians; moreover, that part of the Atlantic was beset with reefs and shoals, and there was every reason for believing that there was no depression in the mountain range.

The Darien route was only partially explored by Mr. Lionel Gisborne, who reported favourably of its capabilities; but subsequent expeditions had invalidated these conclusions, and tended to demonstrate that the Sierras Lloranas formed an unbroken chain from the Gulf of San Blas to the Gulf of Darien. All explorers agreed on the decided hostility of the Indians, and, with the exception of Dr. Cullen, who averred that he had repeatedly crossed the Isthmus at that point, no subsequent explorer had succeeded in traversing it. It was proposed to construct a canal, without locks; but the great difference in the height of the tide at the two extremities (25 to 30 ft. in the Pacific, and only 2 ft. in the Atlantic) would produce a tidal current of such force as to endanger the works, and materially interfere with navigation.

The Atrato route had already been pointed out by Humboldt as likely to afford one of the best solutions of the problem. It was stated that the River Atrato flowed almost due north for a length of 300 miles, in the midst of a vast alluvial plain between two ranges, resulting from the bifurcation of the Andes; it then discharged itself by nine mouths into the Atlantic, by the Bay of Candelaria in the Gulf of Darien. The upper part of the river had been carefully explored by Messrs. Trautwine and Lane, who had both reported against the feasibility of any plan for uniting the head waters of the Atrato with those of the San Juan, which flowed into the Pacific. An exploration on the Pacific side led to the discovery of a depression in the mountain chain between Punto Ardita and Punto Marzo, which was found to correspond in an almost direct line eastward with the Truando, one of the most considerable western affluents of the Atrato.

The route more especially advocated in the paper would commence on the Atlantic side, at the estuary of the Atrato, by widening and deepening one of its entrances, removing the sand bars, and stopping up, by breakwaters and dams, the remaining mouths, so as to direct the full force of the current into the branch called Caño Coquito; or an entrance might be effected by a side cut from the bay into one of the mouths, and the erection of guard gates at each end, by stopping the current, would prevent any deposit or bar outside. At the distance of 2 miles from the mouth the river deepened to 30 ft.: and from this point to the mouth of the Truando was no where less than 47 ft., with an average width of 350 yards. It was then proposed to follow the Truando for 36 miles, deepening and widening its channel where required, to a point named Townsend's Junction. Up to this point the works required would be very simple, as the banks were principally levels formed of sedimentary deposit, and the soil of the bed of the river was of the same character. From Townsend's Junction an open cut was contemplated for a distance of 13 miles. It was then proposed to tunnel through the base of the ridge, a length of 3¼ miles. A double tunnel was recommended, as the width (200 ft.) would require a single arch of too great a height: the division into two arches would also have the advantage of precluding any possibility of collision. The height proposed (120 ft.) would be sufficient to allow of the passage of the largest vessels by merely lowering their top-masts. From the tunnel to the Pacific, a distance of 8 miles, the canal would follow the valley of a small stream, and debouch into Kelley's Inlet.

The line would thus uninterruptedly proceed, without locks, direct south, from the Bay of Candelaria to the junction of the Atrato, 7° 15′ N. Lat. and 77° 8′ 32″ W. Long.—a distance of 67 miles 1,436 yards, whence it would diverge by the Truando to the south-west and terminate at the Peninsular of Paracuchichi or Kelley's Inlet, 6° 57′ 32″ N. Lat. and 78° W. Long.—a distance of 63 miles 1,216 yards. It would thus have a total length of 131 miles 892 yards, with a minimum width and depth throughout of 200 ft. and 30 ft. respectively. The most important point to be considered was the rate and direction of the flow of water from the junction of the Truando with the Atrato, and the supply which might be depended on at that point. It had been ascertained by Colonel Totten, the Engineer of the Panama Railway, that the mean level of the two oceans was very nearly, if not entirely, similar. The difference in the height of the tides at the two extremities of the proposed route was found to be,—at the entrance of the new river in the Pacific 12 ft. 6 in. at spring tides, and 10 ft. 11 in. at neap tides,—while the tidal wave of the Atlantic, at the mouth of the Atrato, never exceeded 2 ft. at any phase of the moon. After careful observation, Captain Kennish had fixed the height of the junction at 15·2 ft. above the mean tidal level of the two oceans.

The junction of the Truando with the Atrato would thus be 9 ft. above the Pacific at the highest tide, and would flow down it with a velocity equal to that head; while, at the lowest tide, the velocity would be equal to a head of 21·45 ft. The summit being at the same height from the mean level of either ocean, and the distance being nearly equal, their average rate of current would be nearly the same,—about 2½ miles per hour. As far as theory could elucidate the tidal influence of the Pacific, it would extend to Townsend's Junction, and pass under the fresh water coming down the river, without commotion either at flood or ebb. That part of the river between Townsend's Junction and the Pacific would be slightly agitated by the rise and fall of the tide, but the velocity of the current would be scarcely affected.

By careful calculation it had been ascertained that the discharge of the Atrato was 667,014,600 cubic ft. per hour, and the mean discharge of the new river would be about 42,000,000 cubic ft. Now, if this were taken solely from the bed of the Atrato, it would only reduce that river one-sixteenth, and its surface level 3⅝ ft., the Atrato being 58 ft. deep at the point of junction with the Truando.

The principal advantages which gave the proposed route the pre-eminence over all others, were claimed to be:—

1st. That the two oceans could be thus united, by an open channel, without locks or any other impediment.

2ndly. That the width and depth would be sufficient to allow of the simultaneous passage, up and down, at all times, of the largest class of vessels.

3rdly. That excellent harbours existed at both ends, requiring but little improvement, and at all times perfectly accessible.

4thly. That the route passed through a country in undisputed possession of a legal government, and among a people favourable, instead of hostile, to the undertaking.

A summary of the estimated cost of the canal, including the works of every kind throughout its whole length, with lighthouses, piers, depôts, &c., as also the execution, medical, and commissary departments, was annexed to the paper. The total, including all contingencies, was fixed at 145,407,042 dollars, or £30,000,000. In constructing the canal of a width sufficient for the passage of one ship at a time, the estimate would be reduced nearly one half.

The vast saving in time and distance which would be effected by this canal was then dwelt upon. From New York to San Francisco, it would be no less than 13,000 miles, and proportionately large for all the ports in the Pacific. Details were given of the rapid development of trade, which was annually increasing between Great Britain, France, and the United States—and the Pacific; and also an approximate calculation of the commercial value of the canal.

In conclusion, the author repeated, that the plan developed was, perhaps, not the only practicable one,—that although the information contained in the paper had been obtained, by sending to the Isthmus four different corps of engineers, fully provided with instruments for levelling and surveying, and they had made complete plans and sections of the route, yet that a more extended survey might suggest the superiority of selecting some other affluent of the Atrato, and some other terminus on the Pacific. His principal object had been to show the practicability of communication between the two oceans by the valley of the Atrato, and that it possessed peculiar advantages for rendering that communication as large and open as the present wants of commerce imperatively required. If such was the case, he thought that it was worthy of an official survey and thorough examination by the Governments of the great commercial nations of the world.

April 29, 1856.

Robert Stephenson, Esq., M.P., President, in the Chair.

The entire evening was devoted to the discussion upon Mr. F. M. Kelley's Paper, "On the Junction of the Atlantic and Pacific Oceans, and the Practicability of a Ship Canal, without Locks, by the Valley of the Atrato."

It was admitted that a correct description had been given of the routes hitherto proposed, and of the valley in question; but that the route by Panama would be found the most economical and most convenient if the communication was made between the River Chagres and the Rio Grande, where there were only 15 or 16 miles from tide to tide, instead of by Chorrera, as proposed by M. Napoléon Garella.

It was objected that Mr. Trautwine, when starting on his expedition, was not supplied with proper instruments for taking a correct survey, and, therefore, that his account could not be implicitly relied on;—that Captain Kennish, on his return to Carthagena, was also in possession of but imperfect levels, and that if the height of the junction of the Truando with the Atrato was not absolutely correct, it would invalidate all the calculations of the work to be performed. But even assuming the figures and levels of the author, it would hardly be possible to execute works of such gigantic proportions without a great sacrifice of life. It was true that Chagres and Greytown were the two most unhealthy places in Central America (and, perhaps, even in the world, 400 out of 600 of the Irish workmen employed on the Panama Railway having died in three years, and H.M.S. *Rosamond* having lost more men in six months off Greytown than during a three years' station on the West Coast of Africa); but the valley of the Atrato was also very unhealthy, as was evidenced by the state in which Captain Kennish returned after his exploration. If the necessity for a tunnel was granted, then other places might be found more advantageous for inter-oceanic communication, and Darien presented greater facilities.

Another objection to the proposed route was the great length of the canal, entailing the employment of steam tugs, which would be found more expensive than trans-shipment by the Panama railroad. Particulars were given of the height of the range of mountains running through Central America, more especially opposite Port Escosces: the summit level was stated to vary between 950 and 1,150 ft., and the apex of the ridge, or backbone, of the Andes, to be so narrow as not to allow of more than five men walking abreast, even supposing it to be cleared of trees. But the chain of the Andes had not been sufficiently examined to ascertain whether or not it was unbroken between the Napipi, where the depression was found to be 300 or 400 feet, and the Panama railroad, of which the summit level was only 250 ft. This was a most desirable point to be assured of before coming to any determination upon the best route; and it was also of great importance that the coast on both sides should be accurately surveyed, to fix upon good harbours, for it was next to impossible to create them; the maps and charts at present in use were not to be relied on. It was doubted, also, whether the traffic would ever repay the cost, for the route from England to Calcutta, or Hong Kong, was actually 600 miles longer by Panama than by Cape Horn; although it was, of course, admitted, that the former route had the advantage of calmer seas, and of the absence of wind, and that this was no argument against the American trade justifying such an expenditure.

The results of observations with the mountain barometer were also given, showing that its variations constituted a regular tide, by a knowledge of which calculations could be based with sufficient accuracy for preliminary surveys, as they would never vary more than 10 feet from those obtained by sections run with instruments.

It was contended, on the other hand, that Mr. Trautwine, Mr. Lane, Mr. Porter, and Captain Kennish had all been furnished with proper instruments, and that the spirit level had been used for the survey of the whole length of the Atrato, and from the Pacific on the west, over the summit of the Andes, down to the river Truando, on the eastern side,—that Captain Kennish was thoroughly qualified for the task he had undertaken; and that the five different surveys which had been undertaken at different times, and by different persons, all agreed in their results. It was admitted that the whole of Central America was very unhealthy; but it was stated that the proposed route was less so than the Isthmus proper. It was submitted that these were not the questions at issue, but whether a practicable route could be made between the two oceans by the valley of the Atrato, and whether sufficient evidence had been shown to authorise an official survey.

A letter was read, addressed by Baron Von Humboldt to Mr. Kelley (after examining the maps and plans), expressing great confidence in the survey made and levels taken by Mr. Kennish and his predecessors. The large number of maps and sections taken on so large a scale furnished all the elements necessary for forming an opinion of a possibility of a communication through the mouths of the Atrato by the Truando, and by a canal to the Pacific. The failure of the expedition in 1852, and subsequently, for exploring the mountainous country between the Gulf of San Miguel and Caledonia Bay, might be ascribed to the want of such plans.

Humboldt expressed an opinion that a free and open discussion would demonstrate the relative advantages and disadvantages of each proposed locality, and there would really be little difficulty in tracing the proper route, wherever there were good plans and sections, such as had been made under Mr. Kelley's directions of the valley of the Atrato; his opinion in favour of that route, as compared with all the others, had always been strongly expressed; and in his works he had even given all the details he had collected relative to the small canal stated to have been made in the year 1778 by the Indians, under the direction of a monk, the Curé of Novita, in order to unite the waters of the river Raspadura with those of the river San Juan, and thus establish a water communication for canoes across the Isthmus. He alluded also to the labours of Captain Fitzroy, R.N., who had, in his report on the Isthmus of Central America, descanted on all the known routes; and he recalled the statement of Lieutenant Wood, R.N., when surveying the coast, to the effect that he travelled on foot, with native guides, from Cupica to the Napipi, in which he bathed, and returned to his ship within six hours, and that the most elevated ground passed over did not exceed 300 or 400 feet. In fact, Humboldt looked upon the proposition of forming an inter-oceanic canal by the valley of the Atrato as perfectly feasible; and he even added, "without locks, or, if possible, without tunnels."

It was due to Mr. Kelley to state that he did not appear as the agent of any other persons; but that he had caused these various surveys to be made solely at his own cost, and that he had already expended large sums for the prosecution of these investigations, which were carried on under his direct suggestions. In further explanation of Mr. Kelley's views, it was stated that originally he had been favourable to the route by the Atrato and the Raspadura; but, subsequently, he became convinced that the route by the river Truando to Humboldt Bay would be preferable. He had, therefore, instructed Mr. Kennish and Mr. Lane to survey that part of the country, and the result had been that the latter route was the one he at present recommended. He was, however, by no means prejudiced in favour of any one particular route. His anxiety was that very accurate and extensive surveys of these districts should be made, under the auspices of the Governments of Great Britain, France, and the United States; and he believed that part of the Isthmus would be found to present more favourable features than any other. With regard to the river Atrato, it was mentioned that it was only to be compared in magnitude with the largest of the American rivers, and was known to be navigable for the largest ships as far as beyond the junction with the Napipi. It would, therefore, not require any change below that point, and the nature of the climate was such as to preclude the probability of the supply of water failing at any season. It also drained the whole valley, in which rain fell for nine or ten months in the year; besides which it received a number of rivers, some of which were of equal size with the Truando, the current of which it was proposed to reverse, so as to turn the water of the upper part of the Atrato into the channel of the Truando, and thence into the Pacific.

Although the mean level of the two oceans was generally agreed to be the same, yet in the northern and narrowest part of the Bay of Panama the tide rose 20 or 30 ft., whilst at Humboldt Bay, to the south, it did not rise more than 12 ft. The high tide level at this latter point was, therefore, nearly on a level with the junction of the Truando and the Atrato —so that the current would not be so great as to prevent navigation, or to damage the works in the channel, as it had been contended would be the case if a canal were made across the narrow part of the Isthmus, where the lift of the tide was greater.

In concluding the discussion, it was stated that the Institution was very much indebted to Mr. Kelley for the paper he had brought forward. It gave a clearer insight than any of its predecessors into the difficulties of the whole problem of an inter-oceanic canal, and it suggested a route which possessed greater facilities than any other that had been proposed. The English, French, and United States' Governments entertained enlightened and enlarged views on the subject, and it was believed that at the proper moment they would lend their strenuous aid in furtherance of this great question, so important to the commercial and political interests of the whole world.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(FROM OUR OWN CORRESPONDENT.)

Southampton, May 23rd, 1856.

A VERY fine iron screw steam-ship, named the *Delta*, was launched from the building-yard of Messrs. Summers and Day, at Northam, on the 21st ult.

She is the property of the Peninsular and Oriental Company, and is intended for their service in the Eastern Seas.

	Ft.	In.
Length between perpendiculars	227	6
Breadth extreme	29	8
Depth in hold	18	5
Tonnage, B.M.	982 tons.	

She has a raised poop and forecastle, with handsome and well-ventilated saloons, and can accommodate 112 first-class and 22 second-class passengers, with stowage for 600 tons cargo.

Three-masted, fore and aft rig, the sails to be laced to the booms, for sailing close to the wind.

Was launched with all the lower masts and bowsprit standiug, screw shafting and propeller being likewise fitted. Launching draught, forward, 8 ft. 10 in.; aft, 9 ft. 6 in.

Her engines, by the same firm, of 210 H.P., are on the direct action principle. Diameter of cylinders, 45 in.; stroke, 4 ft.; three-bladed screw, 14 ft. diameter × 26 ft. pitch.

We shall notice in a future number the result of this vessel's performance with considerable interest, as she is a very beautiful model, and is the first sea-going iron steamer built in our port.

The United States' paddle-steamer *North Star*, belonging to the Vanderbilt line of packets, arrived here this morning from New York, and will sail this evening for Havre. The time occupied was twelve days sixteen hours, with general fine weather.

This vessel presents a decidedly novel appearance, from her long hollow bow, straight stem, absence of figure-head, &c. The engine-beams project several feet above the hurricane-deck, and, being uncovered, are, of course, prominent objects. The principal dimensions of the machinery have been given in The Artizan. We will merely repeat that the cylinders are 60 in. diameter × 10 ft. stroke. The present pressure of steam in boilers is 20 lbs., cut off at 4 ft. 6 in. from commencement of stroke.

When starting deep loaded from port, the engines made 12 revolutions per minute, and this increased to 15 on arrival at destination. With 15 revolutions per minute, their consumption of anthracite coal is two tons per hour, the indicated H.P. being about 1,300; this gives a consumption of about 3·4 lbs. per H.P. per hour, which is a fair result. No blowers are used for the furnaces, the uatural draught being sufficient.

The practice amongst American engineers appears now to consist in keeping the vacuum in condensers about 25 in., with the hot well about 130°, and they maintain that a greater economy is derived from this comparatively bad vacuum than would result from one equal to 27 or 28 in., because, with the hot well at 130°, the feed-water passes into the boiler at the same high temperature, and thereby maintains a better pressure of steam; and also, from having less injection admitted into the condenser, the air-pump has less work to do, and therefore does not absorb so much of the effective power of the engines. This does not agree with Watts's experience, certainly, nor with the general practice of English engineers.

The large steamer lately launched for this line of packets, and named the *Vanderbilt*, will, we hear, be shortly ready for sea.

As she is about 5,000 (U.S.) tons burthen, with overhead engines, like the *North Star*, and cylinders 100 in. diameter × 12 ft. stroke, she will, no doubt, be an object of considerable interest.

NOTES BY A PRACTICAL CHEMIST.

Use of Hyposulphite of Soda in Analysis.—Vohl aud Himly recommend the hyposulphite of soda as a substitute for sulphuretted hydrogen. If a piece of zinc is placed in dilute muriatic acid and mixed with a solution of hyposulphite of soda, sulphuretted hydrogen gas is evolved. If solutions of salts of lead, bismuth, cadmium, &c., are added to this mixture, the corresponding sulphurets are precipitated.

Sulphate of Iron as a means for Valuing Bleaching Powder.—Wittstein and Claud find that this process is inaccurate. The smaller the quantity of chloride of lime that comes in contact with the sulphate of iron in any time given the more completely the chloride liberated is consumed in forming perchloride of iron. Towards the end of the experiment there is always loss of chlorine, as the amount of protoxide of iron remaining in the liquid is then very small. A given quantity of chloride of lime will oxidise more or less sulphate of iron according to the circumstances of the experiment. In no case will four equivalents be oxidised by one equivalent of the protoxide.

Adulteration of Drugs.—Burnt sponge, it is stated, is fraudulently made by adding 2 lbs. common charcoal to 6 oz. common salt.

ANSWERS TO CORRESPONDENTS.

"A Teacher."—To allow inexperienced youths to operate upon such substances as chloride of nitrogen is, in our opinion, quite unjustifiable.

"Mordant."—A patent has already been taken out for the process you suggest—the manufacture of oxalic acid from uric acid. If you could reverse the process we should be much interested. Uric acid is far rarer and more valuable than oxalic.

REVIEWS.

Muspratt's Chemistry applied to Arts and Manufactures.

The various alloys of copper, ordnance metal, bell metal, cymbal metal, and speculum metal, are described in the 18th part. The standard mixture for bells is 78 parts of copper to 22 of tin. Zinc and lead, which are often added, are very far from improving the tone. We may remark that steel has latterly been introduced in the manufacture of bells with a very good effect. Should aluminium ever be brought down to a reasonable price it will, doubtless, supersede all other metals for bell-founding, for which purpose it is remarkably well adapted, both from its sonorous nature and its extreme lightness.

The operation of tinning copper is next described.

The mean loss of weight sustained by the copper in the scouring or brightening preparatory to the application of the tin is 349 grs. per square foot. The amount of tin consumed is 183 grs. per square foot on an average. An excessive consumption of tin is best prevented by maintaining the articles at a temperature sufficient to melt the tin during the operation. An alloy of lead and tin is often used instead of pure tin, and may be recognised by its bluish appearauce. This practice is less hazardous to health than might be supposed, since, when tin and lead are jointly exposed to the action of acid bodies, the former is dissolved in preference to the latter.

A compound of tin and iron, containing one part of the latter to six of the former, has been recommended for tinning copper. The plates, vessels, &c., are heated to low redness, and in that state are briskly rubbed with an ingot of the composition. When cool any excess is removed with a scraper.

The suggestion of Dumas, to use iron filings internally in case of poisoning by any of the salts of copper, is justly criticised by the Editor, who remarks on the slowness and uncertainty of the reduction which must take place. Besides, iron filings, sufficiently fine to swallow, are not always to be found, and when found they are often oily,—a circumstance which would most seriously interfere with their actiou.

Blue verditer is not a true carbonate of copper; but a mixture of carbonate and oxide. It is prepared by grinding up about 222 lbs. of blue vitriol with rather more than an equal weight of common salt, and making it up into a paste with water; 225 lbs. of thin sheet copper, cut into pieces about an inch square, are agitated with 2 or 3 lbs. of sulphuric acid, diluted with water, to free their surface from impurities. The fragments are next washed with water, mixed with the above paste, and placed in the so-called oxidation chest. Every week the mass is emptied into another chest, and back again, until three months have elapsed. Any residual metal is now picked out, the mass carefully washed with a small quantity of water, and filtered. The paste is placed iu a large tub, 12 lbs. of hydrochloric acid of sp. gr., 1·109 being added to every 180 lbs., the whole well mixed, and allowed to stand for 36 hours. 450 lbs. measure of milk of lime, sp. gr. 1·142 are added to every 180 lbs. of the paste, the whole well stirred, and left to settle for about two days. The clear liquid is decanted off, and the blue precipitate repeatedly washed with water. When all traces of alkalinity have disappeared the precipitate is placed in filter bags, repeatedly moistened, and allowed to drain. The mass is then cut into small pieces, and dried at a temperature not exceeding 78° Fahr.

The sulphate of copper, or blue vitriol, is sometimes prepared by oxidising the native sulphuret. More generally it is obtained from the dipping liquor of coppersmiths, and the scales which fly off from the metal. The latter are placed in a wooden trough lined with lead along with sulphuric acid, the whole being agitated and heated by a current of steam, which is introduced by means of a leaden tube passing nearly to the bottom of the tank. 350 lbs. of copper scales yield 1,240 lbs. of sulphate of copper.

Occasionally fragments of brass are dissolved in this manner, yielding a very impure product. The blue vitriol obtained from dipping liquor is of an inferior quality, from the presence of zinc, lead, &c. Even iron has been found in some inferior samples in a very large amount. These inferior varieties are chiefly employed for steeping seed corn in order to prevent the ravages of certain insects.

We cannot help expressing a wish that the Editor, writing as he does for practical men, would avoid certain phrases, which are apt to prove unintelligible. Thus, in one passage which we have noticed, he speaks of "decapulating" the contents of a cistern.

AMERICAN NOTES, 1856.—No. VI.

LAUNCH OF THE "ADRIATIC."

The launch was perfectly successful. The *Adriatic* went into the river without a single superfluity, and it was consequently very difficult to check her headway. When she struck the water she was probably moving at the rate of ten or twelve knots an hour, and her impetus was so great that it was found necessary to drop both anchors. The starboard anchor parted her cable as if it had been a thread, while the larboard was dragged, without catching, for the remaining distance of the river—at that point about seven-eighths of a mile wide from shore to shore. Her speed had been almost wholly checked by the time she reached the Williamsburg side, but her weight and momentum were so great that when she came into collision with the dock she ripped up the planks to the depth of nearly a rod, throwing some of them into the air ten feet high. Her stern-post sustained only a trifling scratch in the encounter. Had the anchors been dropped at an earlier stage of the journey, this petty disaster, the only one of the occasion, might have been avoided.

The appearance of the *Adriatic* fully justified our expectations. She is distinguished by the same symmetrical lines which belong to all of Messrs. Steers's erections. Her marked resemblance to the *Niagara* was the theme of general comment. She is, however, narrower and much sharper in the bows than that vessel, though in other respects the similarity is strong. It is not fair to institute a comparison between the two without taking into account the different purposes for which they were built. The *Adriatic* is designed exclusively for speed—the *Niagara* for speed and buoyancy combined. Each answers its own purpose admirably, and could not be exchanged, with profit, into the service of the other.

The *Adriatic* will go into the Balance Dry Dock immediately to be coppered. It is intended to have her ready for sea in five months. Skilful engineers predict that she will make her trips in eight and a half or nine days on an average. She certainly promises to outstrip any vessel afloat.

YACHTING.

Novel Mode of Classifying Yachts and Determining Allowances of Time in Starts.—The Yacht Club of this city, at its annual meeting in February, appointed a committee of three of its members—viz., L. M. Rutherford, Charles H. Haswell, and James M. Waterbury—to consider the subject of a modification of the existing rules regarding the classification of yachts competing for prizes.

This committee, after several meetings, and upon consulting with several parties experienced in the construction and sailing of yachts, reported to the Club a recommendation that in future yachts shall be classed by the areas of their sails, which, having been unanimously approved of, the committee are now engaged in arranging the details of this system.

The great point is, what differences of time are to be allowed for differences in canvas.

Whilst this committee were in session a copy of "Bell's Life in London" was shown to them, wherein appeared the suggestion of a writer upon the propriety of the general adoption of this system. Our committee, however, did not agree with the allowances there given, as they considered them too small; and after falling back upon the detailed reports of past regattas, coupled with the intimate knowledge of the peculiar features of each regatta, they unanimously agreed upon the following classification and allowances:—

1st Class.—All yachts carrying 3,300 square feet of canvas.

2nd Class.—All those carrying 2,300 square feet and less than 3,300 square feet.

3rd Class.—All those carrying less than 2,300 square feet.

Allowances in Starts.—In the *1st Class*, one second of time per square foot of canvas; in the *2nd Class*, one and a quarter seconds; and in the *3rd Class*, one and a half seconds.

The areas of canvas for classification of yachts, and for allowances of time, to be based upon the areas of the standing sails of a yacht, with this addition, that any other sail may be set in a regatta or race, provided it has been duly measured previous thereto; and, upon this, the allowance of time, due to the area of the sail, will be charged for the whole race.

H.

ON STEEP GRADIENTS OF RAILWAYS, AND THE LOCOMOTIVES EMPLOYED.

By Mr. Charles R. Drysdale, Assoc. Inst. C.E.

Paper read before the Institution of Civil Engineers, April 15, 1856.

Isambard K. Brunel, Esq., Vice-President, in the Chair.

The discussion being renewed on Mr. Drysdale's Paper "On Steep Gradients of Railways, and the Locomotives employed," was continued throughout the evening.

It was stated that on the Oldham incline, $1\frac{1}{2}$ miles in length, with a gradient of 1 in 27, a tank-engine weighing about 27 tons drew at the rate of 15 miles per hour a train of nine loaded carriages, weighing 50 tons.

The dimensions of the engine were—

	Ft.	In.	
Leading-wheels	3	6	diameter.
Driving-wheels (four coupled) ...	5	0	"
Cylinders	1	3	"
Length of stroke	2	0	

It was argued that it was extremely difficult to establish any useful comparison between the working of various inclines, in consequence of the dissimilarity of conditions of local circumstances, and of the different modes of keeping account of the expenses. That instead of fixing the limit of adhesion, as on the Semmering, at eight times the weight on the wheel, as compared with the force of the pull of the engine, it would be practicable to ascend much greater inclines with only five times the weight to the drag of the engine. That the Semmering engines could not be received as any improvement upon the construction of the engines employed ten years ago at the Lickey incline, where two small engines had been in the habit of drawing, up a gradient of 1 in 37, trains of 50 loaded waggons, weighing at least 250 tons, at a speed of $6\frac{1}{2}$ miles per hour; therefore, that one of these comparatively small light engines would be quite able to haul 165 tons over the Semmering incline at a speed of 11 miles per hour.

Though it could not be denied that English railway engineers were formerly prejudiced against any steeper incline than 1 in 100, and had believed that gradients of 1 in 50 could only be worked by means of ropes, yet it must be remembered that fifteen years ago Halifax was approached by a gradient of 1 in 44, and that twenty-two passenger trains per day, besides goods trains, were, without difficulty, conveyed over that incline by locomotives. There was, therefore, nothing new in these steep inclines, nor in the manner of working them. It should also be mentioned, that the result of later experience went to prove that it was more advantageous to rely on the locomotive than on any system of ropes. Not only had the latter system been abandoned on the Euston incline (London), and at Miles Platting incline (Manchester), but even at Oldham, where there was a gradient of 1 in 27 for $1\frac{3}{4}$ miles; the rope was taken away two years ago, and the traffic was now entirely dependent on locomotives.

It was urged that, as early as 1839-40, the Lickey incline had been freely ascended by locomotives conveying trains, without any break in the course; the conditions of the Lickey and of the Dainton inclines, situated on the course of the lines, were very different from those of terminal inclines, such as at Oldham, Halifax, Manchester, &c.

The sharp curves, of not more than 10 chains radius, on the Semmering, must be taken into consideration, as on a gradient of 1 in 42 they would materially influence the working of the engines, at even a moderate speed. The question was, whether it was necessary to have such heavy engines as those of the Engerth construction, or whether it was not more convenient and economical to work inclines by means of two coupled engines, as at the Giovi incline. The latter opinion was strongly contended for, as also that, generally, the inclines in England were worked better, cheaper, and more regularly than that of the Semmering. In the year 1833 locomotive engines frequently ascended the St. Helen's incline of 1 in 30, although the traffic was worked by means of ropes.

Particulars were given of some experiments made with an engine intended for the Santander and Alar railway, in Spain, from which it appeared that upon an inclined plane, at Sheffield, about 300 yards in length and rising 1 in 27, the engine drew up $23\frac{1}{2}$ tons (exclusive of the tender) at a velocity of about $2\frac{1}{2}$ miles per hour. The same engine, when tried on the Lickey incline, on a foggy day, with drizzling rain falling, took up, in the first experiment, a load of nearly 46 tons, in six waggons, at an average rate of about 10 miles per hour, and in the second experiment $29\frac{1}{4}$ tons, in four waggons, at a mean velocity of $18\frac{1}{2}$ miles per hour.

It was again insisted that circumstances varied so much as to render comparison of working the inclines almost impossible. It was necessary either to have special experiments under special circumstances, or to have such a large number of experiments as to arrive at the truth by taking the average of the results. It was evident that the load that could be hauled by an engine was in proportion to the weight that could be put upon the driving-wheels, but that was limited by circumstances.

In order to arrive at some idea of the relative advantage of employing one very powerful, or two less powerful engines, two engines of equal power were taken, their speed and pressure compared, and a similar load of 280 tons was placed behind each. It was thus found that the two engines, when coupled together, took both loads up the same incline in the same time that each had taken up the half-load separately. At Edge Hill, Liverpool, there were three inclines of 1 in 48, 1 in 90, and 1 in 56, respectively. These were still worked by ropes and stationary engines, because, being situated in tunnels, it was found that the condensation of the steam on the rails, when locomotives were tried, so lessened the adhesion, that in these particular cases it almost amounted to an impossibility of carrying out that system.

The important point to consider was the amount of adhesion to be obtained; one-eighth the weight was contended to be a fair average, as under certain circumstances of weather, &c., it fell to one-tenth, or one-fifteenth. That point being determined, the rest was a question of the advantageous employment of steam, and the construction of the engines themselves.

It was stated that the paper should be received as a record of facts, brought by the Author under the notice of the Institution, rather than with a view of establishing any particular ideas as to the modes of working inclines.

It must be evident that the system of working the Giovi incline by two of Messrs. R. Stephenson and Co.'s coupled engines was decidedly better and more economical than the system of using such enormously heavy engines as those constructed from the Engerth design for working the Semmering incline. It was decidedly more economical, as well as more convenient, to be able to work an incline by merely coupling together the ordinary engines of the line, than to have engines constructed expressly for the duty of ascending steep gradients, and unfit for the other portions of the line. Besides, the injury to the permanent way, by such enormously heavy engines, must be considered, when comparing their duty with that of two engines whose weight was so much better distributed.

Circumstances of climate would always affect adhesion; in the fine dry cold climate of Norway inclines could be advantageously worked, whereas in a London fog, or even with the ordinary moisture of a dewy night, the adhesion would be materially impaired.

Ropes had been generally superseded by locomotives, but it should not be rashly decided to abandon them entirely, as there were situations where steep terminal gradients might still be advantageously worked by them; whereas it would be preferable, or even almost indispensable, to work the inclines in the course of a line by locomotive power. The difference between eurrent and terminal inclines must always be considered. The facts observed and collected by the Author would be found valuable as data, from whence every engineer would draw his own conclusions, and apply them so as to meet the peculiarity of his own case.

In conclusion, it was urged that with regard to adhesion no *à priori* arguments should be relied on, but facts alone should be had recourse to, and these, it was asserted, would be found to give the power of adhesion as being from one-eighth to one-tenth of the weight on the wheels. It was thought to be of great importance that the question of the comparative economy of working inclines by locomotives, or by ropes, should be clearly investigated. In hilly districts, if gradients of 1 in 20 could be worked with facility, the construction of many costly viaducts and other structures might be avoided; and, of course, the less the expense necessary to be incurred in the formation of any railway, the greater chance was there of its being satisfactorily executed.

DESCRIPTION OF A SPIRAL COIL PISTON-PACKING.*

By Mr. David Joy, of Worcester.

The piston-packing, which is the subject of the present paper, was designed by the writer to carry out the principle, which appears to him the correct one, for producing steam tightness with the least loss of power from friction and the greatest economy in repairs, namely, by the use of metal in that form in which it will give out the greatest amount of continuous elasticity, that is, by employing a spring acting through a lengthened space with comparativelye slight intensity of pressure, instead of the short and rigid spring or series of springs commonly used in packing metallic pistons.

The piston in which this packing is used is shown in Figs. 1, 2, and 3, and consists of a simple block, into which the rod is screwed and pinned. The periphery of the piston being turned to 1-16th in. less diameter than the cylinder, a recess is cut in it with a half in. tool set at half in. pitch, making 3 in. more than two revolutions, as shown in Fig. 2.

The packing is formed out of a cast-iron or brass ring, 5-8ths in. thick, and 3-4ths in. larger in diameter than the cylinder. The ring is turned and bored, and being placed on a mandrill, a spiral groove is cut in it with a 1-8th in. tool, set at 5-8ths in. pitch, as shown by the dotted lines. This cut being carried through leaves the ring in the form of a spiral coil of half in. by 5-8ths in. section, and of about five full revolutions. A portion of this spiral is cut off, equal to two revolutions and 3-4ths in. over. This is threaded on to the block-piston and pushed down till it drops into the recess, which it exactly fills laterally, as shown in Fig. 3. A sheet-iron cramp is placed round the packing, by which it is compressed to the diameter of the piston, which is then placed at the mouth of the cylinder, the ports being protected by small blocks of wood, and the piston is then thrust from the cramp into the cylinder.

The objects aimed at in this modification of packing are to avoid friction, by obtaining an elasticity as light as possible, yet sufficient to produce perfect contact with the face of the cylinder to ensure steam tightness, and sufficiently continuous to follow up the effects of wear without the necessity of frequent renewal by resetting. And this the writer finds is best accomplished by using a packing which shall consist of the greatest possible length in proportion to its cross-sectional area. No figure meets this requirement so fully as the spiral coil, and the number of coils or length of packing can be increased to any extent that may be found advantageous, the elastic action being always in one continuous length.

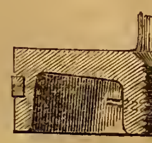


Fig. 1.

Fig. 2.

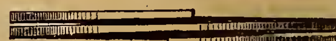


Fig. 3.

As the coil fits throughout its length between the parallel sides of the recess in the piston, its two extremities may recede from each other to any distance that may be found requisite for wearing out the rings without at any time exposing an opening for the passage of steam. The packing under all circumstances fills the recess, except at the bottom, where the vacant spaces at the extremities of the ring, left in the uncoiling of the ring by wear, are effectually closed by the piston-body sliding in contact with the cylinder, that part of the packing-ring being placed at the bottom side of the piston for this purpose. By experiments it has been found that with the 16 in. brass packing, with half in. elasticity of compression on the diameter, and half in. square section of packing, the pressure on 53 sq. in. of surface of packing was 1·92 lbs. per sq. in., or 102 lbs. on the whole packing. It took 65 lbs. to move this piston backwards and forwards in the cylinder, when disconnected from the rest of the machinery and the glands unpacked, equal to 0·32, or about 1-3rd lb. per sq. in. on the surface of the piston. The 16 in. cast-iron packing, with 5-8ths in. elasticity of compression on the diameter, and half in. by 5-8ths in. section of packing, gave a pressure of 4·41 lbs. per sq. in. of surface of packing, and took 135 lbs. to move it in the cylinder as above, being 0·67, or about 2-3rds lb. per sq. in. on the piston. This experiment was made immediately after the engine had done her day's work, when the cylinder lids were taken off, and the glands unpacked for the purpose. Previously to unpacking the glands, the steam at 110 lbs. pressure was put on behind the pistons with a most satisfactory result, there being no appreciable leakage of steam past the piston. A similar trial has frequently been made by merely opening the cylinder cocks, and putting steam on behind the piston, when no appreciable blow is observable.

A corresponding experiment was also tried with a 16 inch piston of the ordinary class, having cast-iron V packings, and it was found to require 426 lbs. to draw the piston slowly along the cylinder, when disconnected as in the other experiment, showing more than three times the resistance.

The new packing avoids the frequent necessity for "looking at" the piston, which is so large an item in the expenditure of locomotive running sheds, and this is in a great measure a consequence of the accomplishment of the former object, as the large amount of elasticity resident in the coil will wear out the packing without the necessity of examination for renewing that elasticity by means of resetting the springs, as in ordinary pistons.

This piston has also the advantages of simplicity of construction and freedom from parts liable to get loose and produce breakage of pistons and cylinders. As this packing is used in a block piston it does away with the necessity for lids, nuts, screws, guards, &c., and reduces the piston to its fewest possible number of parts—the rod, the piston, and the split pin to secure the rod to the piston. The packing-ring also being always confined in a recess of a cross section exactly equal to its own, if broken, can produce no injurious effect, as it must always remain in its place as if whole. The time required for removing the packings is very short, the cylinder lid being taken off and the cross head cotter knocked out; the piston is then drawn out, when the old packing is threaded off the piston and a new one threaded on in ten minutes, and the piston replaced. From the long enduring elasticity of the coils they are expected to last without examination at least 15,000 miles, the only need for examination being for the purpose of cleaning. There has not yet been time actually to wear out a ring, but as data upon which to form an approximate opinion, the ring marked No. 2, which is exhibited, has run more than 10,000 miles, and when taken out did not blow.

The new packing is also attended with economy in original cost, as the expense of piston and packing shows a considerable reduction on those generally in use.

After the meeting, Mr. S. Thornton, of Birmingham, exhibited a powerful hydraulic lifting jack, capable of raising a load of 50 tons by the power of a single man; the ram being 8 in. diameter with an 8 in. stroke, and the pump 3-4ths in. diameter; the whole apparatus was arranged in a compact cast-iron box, weighing about 2½ cwt. altogether.

Mr. G. M. Miller, of Dublin, also exhibited a specimen of an improved axle-box, used upon the Great Southern and Western Railway of Ireland.

* Paper read before the Institution of Mechanical Engineers.

RECENT ENGLISH PATENTS.

IMPROVEMENTS IN GAS REGULATORS.

This invention is a communication to Mr. William Smith, of 10, Salisbury Street, Adelphi, Civil Engineer, and consists in a novel and peculiar construction and arrangement of apparatus, and method of combining and operating the parts thereof, for regulating and controlling the pressure at which gas or other fluids are delivered through supply-pipes, and, more particularly, the pressure at which gas in general use is supplied to the burners, whereby the pressure at which it is consumed, and, consequently, its rate of combustion, is more constantly and permanently equalised and maintained at a uniform point, the regulation being exclusively and entirely effected by the action of the gas *that has passed the regulating point*, and is not sensible to, or affected by, the higher variations of pressure in the mains.

It performs for the consumer that which he otherwise is only able imperfectly to accomplish by continually altering his gas taps.

That gas is most economically used when delivered at the burners at a uniform low pressure—considerably lower than the average pressure in the mains—has become a well-established fact, while the sanitary benefit resulting is also important.

In the various ingenious devices that have heretofore been invented to accomplish this purpose, serious defects have been found to exist, or the means used to remedy those defects have caused the apparatus to be more complicated: as, for instance, in those generally worked on the principle of a hooded disc, or of a diaphragm yielding to the pressure of the gas, and by its action moving the valve, and thus closing or opening the valve aperture, the regulation has been defective, by reason of the valve being affected by the pressure in the main as well as by that in the branch or service pipes. And in those later ones in which a compensating chamber and an additional disc is connected with the valve, in order to balance the pressure from the main upon it, and small tubes introduced to communicate between the chambers under the moveable gasometer discs and the branch pipes, the apparatus is greatly complicated thereby. Again, all the foregoing arrangements have necessitated the placing of the valves, seats, and valve gear at the bottom or lower part of the regulator, whereby the water, constantly accumulating in the gas pipes, and too frequently neglected to be drawn off, first reaches and affects the operation of these parts by corroding and fouling them, besides, for the time being, drowning and obstructing them by its presence. And again, as in most places, the gas manufactured for the public holds in suspension so much tar and resinous matter as to deposit, in longer or shorter periods of time, a coating of these substances upon the valves and valve-seats of sufficient thickness and hardness to throw the regulators quite out of action—as these have heretofore been constructed—and it has then become necessary to detach and take them down to repair and properly remedy this difficulty, making it necessary, after disconnecting them and removing this impediment, to again attach them to the piping with nearly as much labour as at first.

By the present invention these difficulties and defects are avoided, and the balancing or compensating apparatus and attendant complications dispensed with, while greater sensitiveness in the action of the regulator is secured, and its construction and operation greatly simplified, its liability to leakage or derangement, from *long-continued* use, reduced, with much greater facility for examination, cleansing, and adjustment, when permanently attached, for the purposes of removing the impurities deposited by the gas, and its adaptation to every position of piping largely increased; at the same time, the apparatus is reduced to smaller compass.

In the drawings accompanying the specification there are fourteen figures in illustration of the invention, but the subjoined woodcuts exhibit two views, and will serve to make the chief features of this invention understood.

Fig. 1 represents a sectional elevation of the apparatus.

Fig. 2 represents a similar view of a regulator with two outlets.

The body of the regulator, R, may be made of any suitable material, but it is preferred of iron, made in one piece, of cored casting; it is arranged in circular or concentric divisions, which furnish an outer, A, and an inner channel or trough, B, for a mercury (or other suitable fluid) lute. The outer channel or trough of mercury receives the rim of the regulating gas-holder disc, G, the inner one receives the lower rim of the small cylindrical vessel or floated barrel-valve, V, which is attached by the spindle, S, to the gas-holder, G, and actuated by the latter as it rises or falls with the varying pressure of the gas. The central piece that contains the annular trough for the inner lute is supported in its place by brackets or arms placed across the space, C, connecting it with the next outward annular partition, and one of the arms, extending quite across the next outer space, H, by being bored, affords a lateral pipe or channel, *a*, for the mercury to flow between the inner and outer lute. The remaining divisions furnish the annular space or channel-way, C, for the passage of the inlet current of gas which has been admitted by the inlet, I, and which, passing up through the aperture, D, formed by the valve-seat in the top piece, E, into the regulating chamber, K, passes thence down the annular channel-way, H, and, self-regulated in the amount of pressure by its action upon the disc, G, passes out through

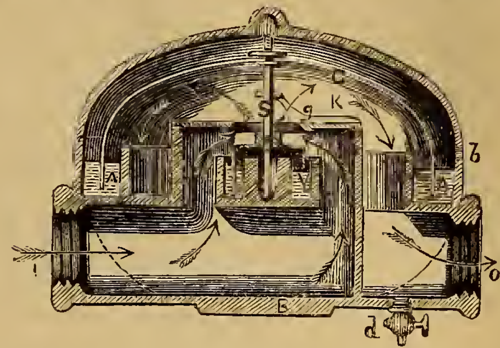


Fig. 1.

the outlet, O, in the centre piece within the circumference of the inner lute channel. There is yet one more central tubular channel or space, N, which receives the lower end of the spindle, S, and, in connexion with a hole, *n*, in the guide, *g*, that forms part of the top piece, E, serves to

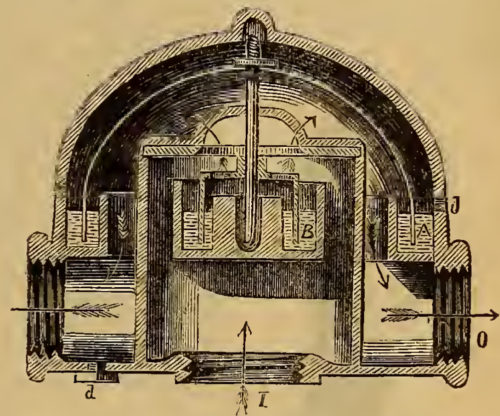


Fig. 2.

guide and keep the spindle perpendicular, and, through it, the gas-holding disc, G, steadily in its proper position; by means of a screw-thread in the spindle, S, at the point of attachment to the valve, V, and two screw-nuts, by which the spindle is attached to the gas-holder, G, the lift of the valve may be shortened as desired. The top piece, E, is turned and ground to fit tightly into the top of the receiving chamber and passage, C, and is readily adjusted in or removed from its place; across its top part and of one piece with itself is raised a guide piece or bar, *g*, having a hole, *n*, in its centre to guide the spindle. The outer ends of the guide piece or raised bar project beyond the outer rim of the top piece, E, and of the annular chamber, C, for the purpose, when the disc, G, is removed, of quickly lifting the top piece off, and with it the valve, valve-seat, and entire valve gear are thus easily and immediately brought under examination to be cleansed of any impurities deposited by the gas, or when from any motive it is desired to examine or inspect these parts of the apparatus, which can again be as quickly and easily returned to and secured in their place without disturbance otherwise to the regulator, its mercury, lute, or its attachment. The regulator is provided with an overflow channel, *b*, to prevent the mercury trough being filled too full by careless or unpractised hands, and with a tap for drawing off the mercury or other fluid used for a lute; it is further provided with a water-tap, *d*, for drawing off the accumulation of water deposited by the gas in the pipes, and with air-holes, *e*, in the lid to allow unimpeded motion to the gas-holder disc in rising and falling with the varying pressure of the gas beneath. In the top of the cylindrical vessel, V, holes are pierced through, in order to allow free communication between the space beneath and between it and the surface of the mercury and the outer space without the cylinder, and an equality of pressure on both the inner and outer side. Over all is put the lid, L, which is secured to the body of the regulator by screws and screw-locks, *h*, at the edges.

The following is a description of the action or working of the regulator:—

The gas being admitted from the main by the inlet, I, passes into the receiving chamber and the annular passage, C, within the circle of which is placed the cylindrical inverted cup, or barrel-valve, V, so that the current of gas passes over its upper rim and between it and the circular opening, D, and through the latter into the domed regulating chamber, K, underneath the dome, G, which is also floated in an annular trough of mercury; and, sensitive to the slightest pulsation or inflation of pressure of the gas within it, rising and falling in its lute in correspondence with the increase or diminution of pressure. Through its connexion by the spindle, S, to the cylindrical fluted vessel, V, before referred to, it lifts the latter in rising up towards the conical sides of the aperture, D, which are nicely ground and accurately fitted to the upper rim of the cylinder, and forms the valve-seat. The cylinder, V, thus diminishes or cuts off the flow of the gas through the aperture proportionately to the requisite force and quantity of the gas being consumed. The lift of the domed chamber, G, being limited by the contact of the valve and valve-seats, and when the pressure falls below that of its adjustment, it falls down until its lower rim rests upon the bottom of the mercury trough, upon the top of the dome, G. Washers, or flat rings of lead of suitable shape, may be placed (as represented, by dotted outlines, *m*, in Fig. 1), by which the degree of pressure at which the apparatus is to work may be adjusted.

It will thus be seen that the pressure of the gas in the main, to whatever height or degree it may vary or range above the point of adjustment at the regulator, cannot possibly affect the regulation, because the cylindrical vessel, V, by its peculiar construction and arrangement, is totally insensible to such pressure, which bears upon its outer surface concentrically in such manner as to neutralise or counterpoise itself so far as any influence upon this vessel, affecting its motion, is concerned; and because the regulating chamber can only be reached or operated by the gas that has passed beyond the valvular vessel, V, and is only sensitive to the pressure of the gas in the branch-pipes, and of that within the chamber itself, so that neither the chamber nor the valve are influenced or operated in any degree by the pressure of the gas in the main. And thus the great desideratum in a perfect regulation is attained, while the complications of compensating chambers, discs, and weights of levers, fulcrums, and jointed rods, balance weights, supports, and lifts are dispensed with; close-fitting movements and hinges, liable to become clogged with the first deposited impurities of the gas, avoided; the liability of the long slender spindles of previously patented regulations to bend and thus derange the valves escaped from; the greater amount of regulating surface, and greater spaciousness of the communicating channels renders the action quicker and more sensitive, while the continuous permanent action and efficiency of the entire apparatus are better secured and provided for.

It will be apparent from the foregoing that when the instrument is once adjusted to a given pressure, the gas issuing from the burners will never exceed that pressure, without respect to the higher pressure in the mains, or to the number of burners lighted or extinguished.

IMPROVEMENTS IN PROPELLING VESSELS.

William Hewitt, *of Bristol, in the County of Somerset, Gentleman, for Improvements in Propelling Vessels.*—[Sealed the 11th December, 1855.]

I propose by my invention (amongst other minor advantages) to regulate the action and force of the floats or blades used in those vessels called "screws," so that the maximum or minimum force or resistance may be applied or offered to the sea by such floats as the state of the ocean may require. I propose by my arrangements to render unnecessary the "well" or space allotted in screw steamers for raising the screw, as I anticipate being able to render such space unnecessary to the purpose for which it is now applied, and so save it for general uses. In effecting these objects, I propose to use a double wheel (say, with outer and inner rings), the inner circle of which will be attached to a moveable casing (on which the wheel and floats or blades work); this casing or cylinder will revolve upon a fixed shaft. I intend to arrange the floats between the casing and the outer circle of the wheel, and in such manner as they shall be diagonally (say, at an angle of 45 degrees), but the floats or blades will be so arranged as to permit their being feathered or fixed at any angle required, or fixed vertically, should it prove desirable; and these alterations will be effected without taking up the screw by the means to be provided by the mechanical arrangements I intend to employ for this purpose. My improvements are entirely independent of the nature of the propelling power, whether such power be steam or any other.

It is needless to dwell upon the fact that a successful mode of altering

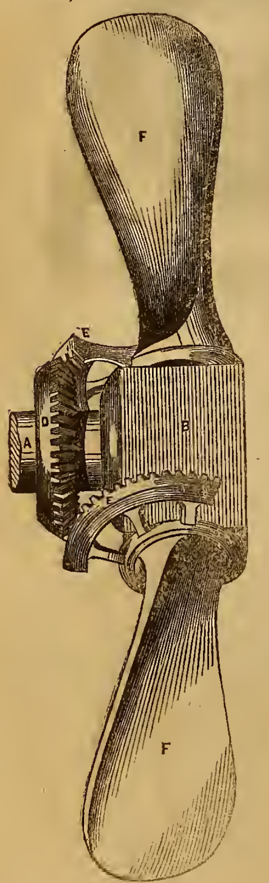


Fig. 1.

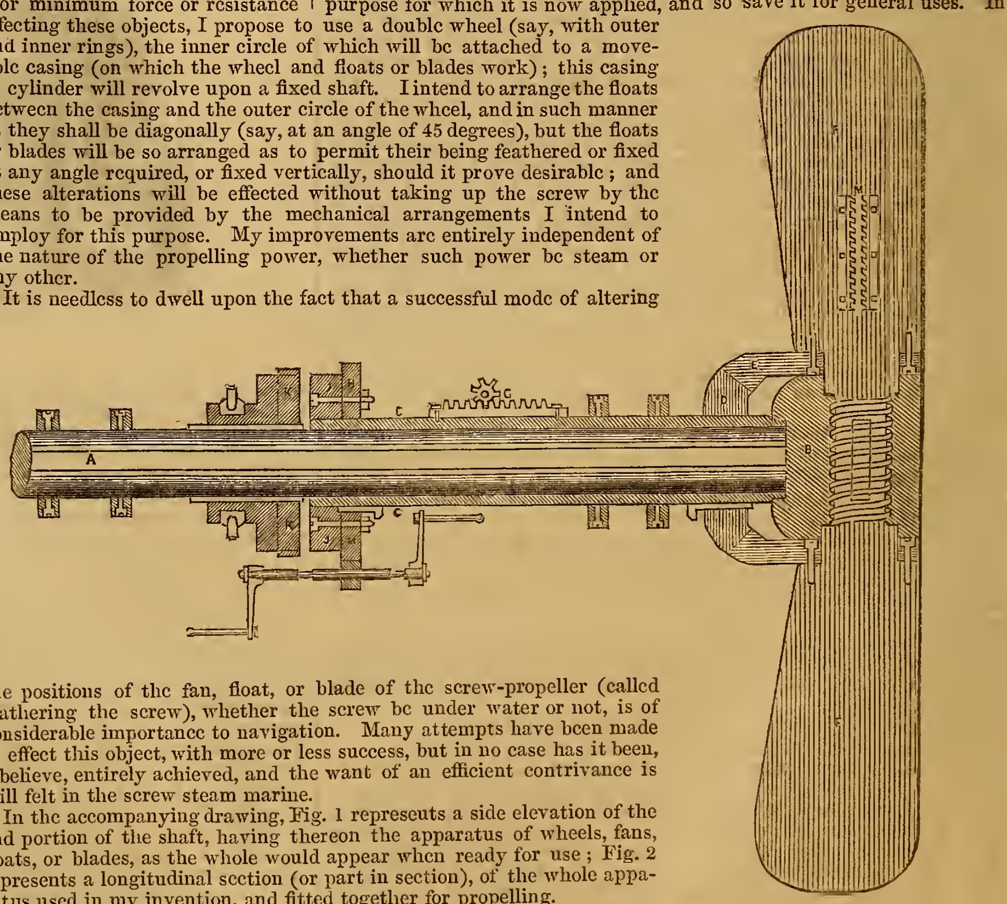


Fig. 2.

the positions of the fan, float, or blade of the screw-propeller (called feathering the screw), whether the screw be under water or not, is of considerable importance to navigation. Many attempts have been made to effect this object, with more or less success, but in no case has it been, I believe, entirely achieved, and the want of an efficient contrivance is still felt in the screw steam marine.

In the accompanying drawing, Fig. 1 represents a side elevation of the end portion of the shaft, having thereon the apparatus of wheels, fans, floats, or blades, as the whole would appear when ready for use; Fig. 2 represents a longitudinal section (or part in section), of the whole apparatus used in my invention, and fitted together for propelling.

On reference to Fig. 2, it will be seen that *a* denotes the main shaft of the propeller, on the end of which is fitted a boss or nave, *b*; or the boss may be welded thereon if desired, and according to the nature of the metal used; or otherwise constructed, as may be most expedient. Encasing this shaft in a portion of its length is a cylinder or tube, *c*, of strength proportionate to withstand the lateral shocks to which a screw-propelling apparatus is always liable. On that end of this casing nearest the stern of the vessel is adjusted and secured a bevelled wheel, *d*, the cogs of which wheel work or gear into those of two quadrant-shaped racks, *e*, *e*; these racks or quadrants are firmly secured to the floats, fans, or blades, *f*, *f*, in the position shown in the drawing at both Figs. 1 and 2 thereon. Again, in Fig. 2 may be observed a rack and pinion marked *g*, which are fixed to the outer casing or tube, *c*; the use to which the rack and pinion is applied is to put the bevelled wheel, *d*, in or out of gear with the quadrant-shaped racks above described, *e, e*. The tube or casing, *c*, is moved (over the main shaft) in a rotary direction or motion by means of the wheel, *h*, fixed or attached to the female clutch on the said casing, with the assistance of a pinion, *i*, working without the casing. By particular reference to Fig. 1, it will be seen that by means of this pinion, *i*, acting, as aforesaid, that the blades, floats, or fans can be moved, set, or feathered to any required angle, the quadrants being placed on the floats or blades in such manner in the drawing, that if they were working in the water little or no resistance would be made to their stroke thereon or therein; but when the opposite ends of the quadrants, *e, e*, commence to gear or work into the wheel, *d*, the feathering and consequent impingement on the water and resistance of the latter commences. To effect this, or, in other words, to obtain the propelling power, it is requisite to turn the pinion, *i*, by a handle, as shown; this imparts motion to the tube or casing, from thence to the wheel, *d*, which acts on the quadrant-shaped racks affixed to the screw-blades, as aforesaid, and by this operation the fans, floats, or blades which are screwed into the boss or nave, *b*, are acted upon, and can be moved in either direction, left or right. The screw-blades being immersed in the water would render it difficult to ascertain at what angle they might be working at any given time; but to provide against this uncertainty, a female clutch, *j*, is fixed on to the side of the wheel, *h*, attached to the tube, *c*, with cuts or grooves (as before described) cut round the face of it, and numbered with the different degrees requisite for the working of the screw, fans, or blades. A male clutch, provided with a tongue across its surface, is made to traverse on the main shaft, and when the fans or blades are feathered or set to the required angle the male clutch, K, is forced forward by means of a lever, *l* (Fig. 6), and into whichever cavity or groove it is intended to be fixed, the shaft being then set in motion, the propelling power is obtained. I may here observe that the clutches, racks, and pinions are all within the engine-room of the ship, and consequently under the immediate control of the engineer. In case of accident to one or other of the fans or blades, rendering its removal necessary or desirable, I have made the following provision for that purpose:—On each side of the blade, float, or fan is fixed a left-handed screw-worm; a left-handed long screw-key is made to fit the worm, *m*, and on the screw of the said key being inserted into the worm, *m*, and turned to the left, the blade will be unscrewed out of the boss, and can be taken in-board. Previous to this operation care should be taken to draw the tube or casing, *c*, back, so as to throw the wheel, *d*, out of gear with the quadrants, *e, e*, on the blades. To replace or renew a float or blade, it should be let down into its place by means of the key, and another key dropped into the top or end of the float or blade and turned to the right hand, which will screw the fan or blade into the boss, and at the same time release the fan from the screw-key.

ROYAL SCOTTISH SOCIETY OF ARTS.—April 28, 1856.

James Elliot, Esq., Vice-President, in the Chair.

1. *On a Method of producing an intense Lime Light by the Bunsen Lamp, without risk of Explosion.* By Alexander Bryson, Esq., F.S.A., Scotland. The Lime Light was exhibited.—The apparatus consists of a Bunsen's lamp, with the addition of an interior tube flattened at the top for the emission of the oxygen. This inner tube is carried up nearly to the top of the Bunsen lamp, and the two gases (oxygen and hydrogen) are mingled at the point of ignition on a flat disc of lime. The frequent explosions, which render the lime light so troublesome, are thus avoided, and it burns with all the steadiness of a moderator lamp. When the gases are used in proper proportions, the light was stated to be very intense.

2. *Specimens of Torbane Coal, and of the Products of Distillation of Coal.* Presented by Dr. Fyfe.—After making a few observations on the composition of coal, Dr. Fyfe presented to the museum of the Society specimens of the products of its distillation, to which he had referred in the paper read in 1854, such as tar-liquor, ammonia water, naphtha, naphthaline, paraffine, paraffine oil, &c. Specimens of the same substances, procured from Torbane coal, were also presented, along with specimens of the different cannel-coals of Scotland, accompanied with a statement of their composition, pointing out the per-centage of volatile matter and of coke afforded by each, and the quantity of fixed carbon and of earthy matter in each of the cokes. Dr. Fyfe also exhibited some specimens of Torbane coal containing fossil remains, some of which were large and entire. The composition of the coal containing these, and which was marked on each specimen, Dr. Fyfe stated he had found to be the same as that of the other pieces of Torbane coal which he had analysed and laid before the Society in 1854, with only one exception. In it the composition more nearly resembled that of common cannels. A piece of a trunk of a tree, of about one foot in diameter, found imbedded in Torbane coal, was also exhibited and presented to the museum. The composition of this tree was also the same as that of the other specimens containing the fossil remains, with the exception of the bark, in which the per-centage of volatile matter and of coke was nearly alike, while the earthy matter was small as compared with that generally existing in Torbane coal. The coke of the bark also resembled that got from English caking coal; the pieces, when taken from the vessel in which they were heated, being joined together, whereas those from the Torbane coal were always separate.

3. *Remarks on the present Patent Laws, and the Manner in which they are administered.* By the Rev. James Brodie, A.M., Monimail, Fife.—Mr. Brodie, in this paper on the British Patent Laws, showed that the expense imposed on inventors is most oppressive, amounting to at least £200 for every complete patent for fourteen years. He also showed the absurdity of some of the regulations of the Patent Law Commissioners, and the call that there was for an inquiry into the whole subject, the encouragement given to inventors abroad, while they are opposed in Britain, having lowered us in the rank of producers and enabled other nations to excel us in those manufactures in which we formerly stood pre-eminent. He also showed the injurious effects which the systematic oppression of talent and ingenuity produced on the social and moral condition of our more intelligent artisans, who finding property protected and honoured, while inventive talent is repressed, feel themselves to be injured, and naturally become discontented. To this cause he attributed in no small degree the Chartism and infidelity which prevailed among our manufacturing classes.

Thanks voted. Referred to the Council.

4. *Description and Drawings of a Simple Apparatus for Boring Cheeks of Cranes, and other similar Purposes.* By Mr. George H. Slight, engineer, 34, Leith Walk.—The author stated that this apparatus was constructed and principally used for boring the cheeks of Henderson's patent Derrick cranes, and consists of two parts, one stationary, fitted up immediately within the outer wall of a workshop, with toothed gearing, driving pulleys, and clutches, for driving a spindle in either direction, or disengaging it. This spindle extends through the outer wall, and has on its outer end a fixed fork or double driver. The other part of the apparatus is attached to the stem of the crane to be bored, and consists of two light angle iron frames, fixed temporarily by being jammed against the sides of the crane stem by two bolts. In each of these frames a round cast-iron bush is supported by set screws and hung in the same manner as a ship's compass, so that it is capable of adjustment in any direction, and has the power of adjusting itself to the direction of the boring bar which it supports. The boring bar is turned parallel throughout, and has on one end a fork, to connect it with the one on the driving spindle, and attached by a pin which allows it to move sideways and adjust itself to the driver, thereby almost entirely removing bending strain from the boring bar. Cutters are fixed in mortices in the bar, and the bar is moved sideways in either direction by a screw working in a spherical nut, which allows a certain amount of obliquity between the direction of the bar and the screw. The crane stem, while being bored, is simply blocked up to bring the bar nearly in a line with the driving spindle, a considerable deviation being allowable without any serious risk of lateral strain to the bar. Different sizes of boring bars and supporting bushes are employed, the same frames answering for all.

5. *Chattaway's Patent Central Buffing and Drawing Apparatus for Railway Rolling Stock.* Described by Mr. E. D. Chattaway, Meadowbank House, Edinburgh. A full-sized model was exhibited.—The patentee stated that in this contrivance the buffer and draw-hook are combined in one piece or arrangement, and the buffer-head, instead of being a plain circular disc, is made of an irregular form—the lower part being curvilinear, whilst the upper part is a long narrow projection. The inner side of this projection is shaped to act as a draw-hook for the reception of the coupling-link of the adjoining carriage, which being made wide for the purpose, works upon it as upon an ordinary draw-hook. The draw and buffer-rod is made with a screw-thread near its end, just within the buffer-head, and carries an adjustable nut and collar apparatus with projecting arms, carrying a wide coupling-link. In this way the coupling can be drawn hard up or slackened off, as occasion may require. Instead of adopting the screwed spindle and collar arrangement for tightening up the coupling, the nut may be dispensed with and the rod left plain, or the collar working loose upon it, and carrying a pin connected to it by a chain, such chain being for insertion in vertical holes bored through the rod. There is an average saving of 40 per cent. in cost and 60 per cent. in weight with this coupling apparatus as compared with the various systems at present in use, with much less injury to the carriage-frames, from the patent buffer being in the centre.

CORRESPONDENCE.

To the Editor of The Artizan.

Sir,—As I believe it is admitted by the first authorities on agriculture that there exists an urgent necessity for a deeper and more thorough cultivation of the soil, I shall not preface these remarks by an argument to prove the truth of this, but will simply confine myself to a description of my system of steam agriculture, stating at the same time my reasons for advocating it. And I must here remark, that as the principles of the system about to be described were arranged *prior* to the date of my patent, they should be viewed altogether apart from any opinions expressed subsequently.

Now, although the application of steam to agriculture is not *new*, yet up to the date of my patent no thoroughly *systematic* mode of applying it has been proposed which might be considered practicable for general adoption. I endeavoured to strike out something *systematically original*—in other words, something original, not merely as a part, but as a whole system.

My ideas were formed upon the following basis:—First, that any system which embraced steam as applied to agriculture must be an entire system, disposing entirely of horse labour, otherwise a farm is entailed with the expense both of horse and steam power, besides being liable to what is so great an objection—the trampling and soddening of the soil by the hoofs of horses. Secondly, any system of applying steam to agriculture must be a question for the landlord rather than the tenant, as steam power to be used effectually must be stationary and permanent. Of course the landlord, having provided the means of cultivating the land by steam power, would naturally look for an increase of rent of a corresponding amount to the capital expended.

Now, although I have not made an experimental trial, yet if I lay before the public a system which is admitted by competent authorities to be thoroughly mechanical, capable of thoroughly cultivating the soil without the aid of horse power—if I prove to them that their crops may be greatly increased with a much less quantity of manure than is at present used by the continual renewal of the surface of the soil by trenching—that the outlay expended will be repaid to the landlord in twelve or fourteen years—and that the machinery once provided will last for forty years and upwards—I think that then the system cannot fail to recommend itself.

To effect these objects I propose, in the first place, to employ permanent stationary steam-engines. In the accompanying view there are five; the area of land represented being 200 acres, supposed to be ploughing land. The four corner engines are of about 8 H.P. each; the centre engine being from 9 to 12 H.P. The powers of engines would depend upon the size of the area cultivated and the nature of the soil. I calculate that I shall require a traction of 8 H.P. in heavy clayey soil to trench to a depth of 18 in., taking also into account the weight and friction of the wire rope, &c. This depth, however, would seldom be necessary, nor would it be practicable in all soils. When once the soil has been thus broken up, by trenching of course, a considerably less power would suffice. I do not propose to make use of the centre engine in connexion with two trenching ploughs, the necessity for trenching the land not occurring every year; it would, therefore,

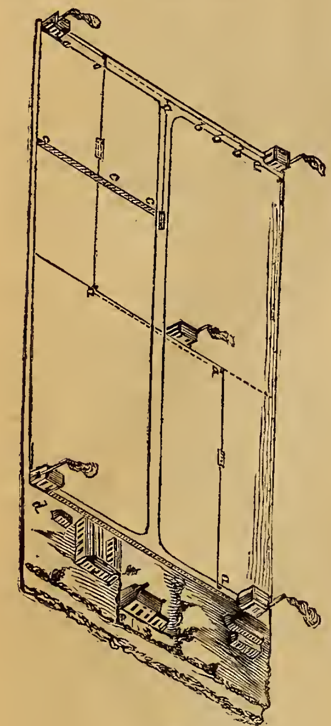
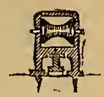
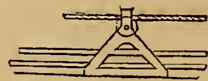


Fig. 1.





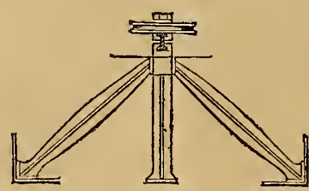


Fig. 2.

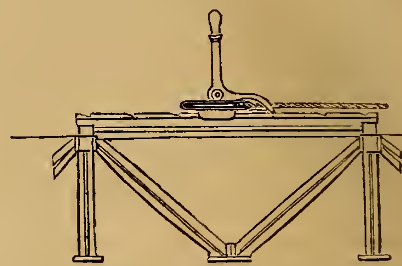


Fig. 3.

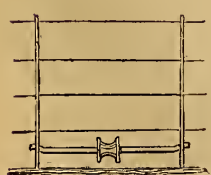


Fig. 4.

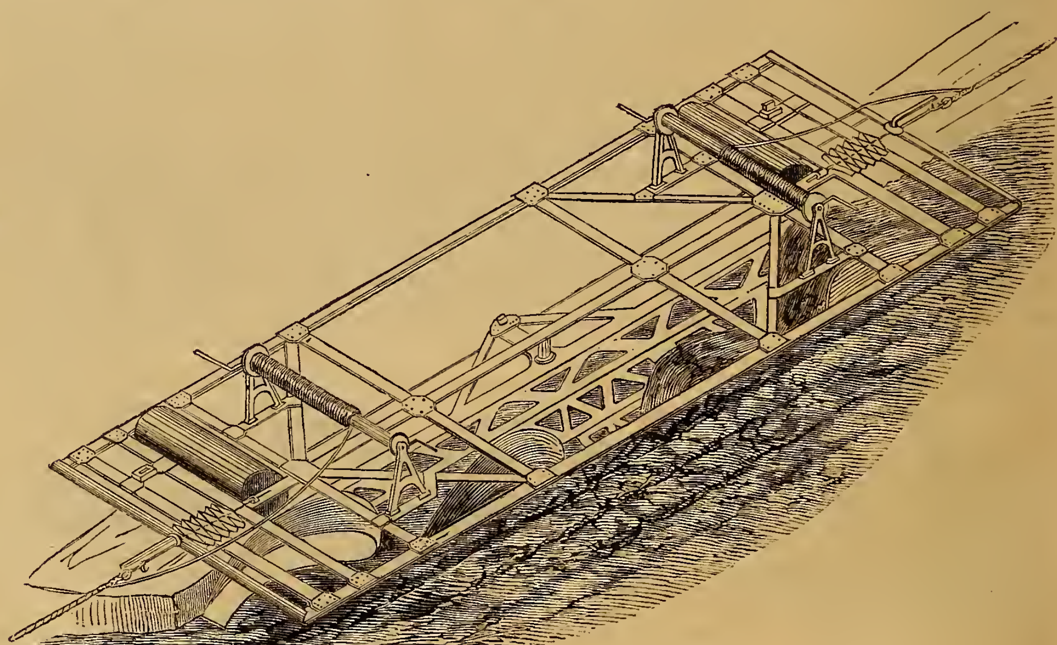


Fig. 5.

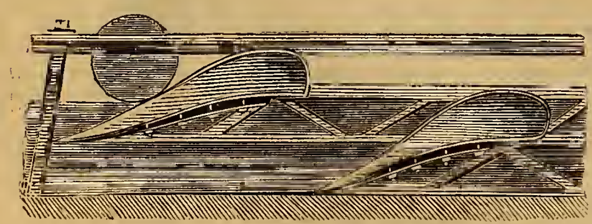


Fig. 6.

be used with one or more of the four corner engines, according to the draught of the implement or implements in operation.

The area of 200 acres shown is much larger than is at present usually cultivated in one enclosure, though not more perhaps than is under tillage in many farms. Where the extent would be an objection, the wire fencing shown at *c c* may be made use of.

I adopt permanent stationary engines, because I believe they would prove far less expensive than others, all things considered, and far more effective. For the same reasons I propose the permanent fixed framework. In its simplicity and neatness, the steady fulcrum it affords, keeping the implement in a direct line, and merely requiring a lad to attend to the lever pulley, I think it would be found to answer far better than any temporary fixture. Where timber is plentiful the framework might be made of wood.

I claim especially under my patent the right of using a wire rope in a right angular direction from the engine to the implement. I thus reduce the amount of friction as much as possible. The rope is of iron wire. Its weight would be about 3 lbs. per fathom. The price, say 50s. per cwt.; made of the best Tintern Abbey wire. The whole length of wire required for the area shown would be about 800 yards. I propose to have it jointed about every 50 yards in such a manner that it can be easily disunited, so as not to overload the drum. The joint would be also useful where parties would wish to divide the land by wire fencing, as shown at *c c*, when the fence might also be used for the purpose explained by the detailed drawing. I do not state a price for the iron framing, as it would vary according to the fluctuation of the iron market, and the nature of the soil.

By reference to the accompanying view, it will be seen that the iron bar on which the pulley works is notched at equal distances, according to the action of the plough. The under side of the bar has a single notch, adapted to other implements. The fulcrum pulley sliding on the bar is from 15 to 18 in. in diameter. The lever attached is raised by the attendant, so as to release the tongue from the notch to allow it to catch in the next notch. The moveable bar is kept in its place by means of a bolt. Why I propose a *moveable* bar is to save expense. If desirable, the bar or rail might be a fixture along two sides of the estate.

About every fifty yards, as at *b, b, b*, is a moveable roller (as explained by the detail) in the line of traction over which the wire rope passes, to diminish friction. I also adopt small carriage and stationary rollers elsewhere, but which I deem unnecessary to describe at present.

I am aware that there are differences of opinion as to the friction of long wire ropes; but these differences, I presume, only arise in proportion to the nature of the method of conducting the rope. I cannot but think that in many instances the friction due to the mode in which power is communicated to the drum is frequently charged to the *rope*.

The signal I propose to adopt, if one should be necessary (and which is described in the remarks on the plough), is Gluckman's Patent.

In conclusion, I may add that my patent only extends to the apparatus for propulsion and to the plough, although I have designed the other various agricultural implements required adapted to this system, but have not attempted to hold them under this patent, as I am no advocate for monopoly. The system I have endeavoured to describe would, I believe, be found to answer both on level and inclined planes, especially where the work is so harassing to horses.

My remarks, however, are not the result of practical experience—steam power, as systematically applied to agriculture, is only in its infancy—nor can I offer a mechanical or agricultural education to back me in endeavouring to impress the importance of the subject upon the public mind. My experiments in agriculture have been very limited—only, in fact, such as fall to the lot of an amateur gardener—and have been confined to an area of some fifty square yards. As this subject has hitherto appeared to baffle the attempts of the mechanical public, I merely suggest these ideas as an attempt to solve the vexed question, "*How is steam to be practically and economically applied to agriculture?*" Should this, my first attempt, fail, it will not cause me any disappointment. Success does not always attend the most earnest efforts to obtain it. I wish the system to be tried on its own merits, and I am content, let the result be what it may. Of course, it is impossible to provide on a sheet of paper for every species of difficulty one may have to encounter; but as difficulties present themselves I feel confident they can be overcome.

The whole weight of the plough rests upon the two rollers, the shares being always in a state of suspension, their under side having no fulcrum upon the soil. The plough, as patented, has *three* shares at either end, but in the accompanying sketch it is shown as I propose to use it in the onset, and until the soil is somewhat free from stones, &c., when I calculate being able to work it at a speed of four miles per hour. I also propose to add a wheel between the two centre shares to work in the trench when the soil is light, by which the friction of the surface rollers will be diminished.

Before commencing to work the plough a trench is opened along the field about two feet wide, and the depth to which the plough cuts, along one side of which the plough commences its work in the manner explained by the sketch. The action of this plough is such as to thoroughly reverse the soil to a depth of 16 in., the width to which each share works being 8 in. The plough does not turn round at the end of the furrow, the shares being arranged, as will be seen, to enable it to work in either direction. A coulter, which I term the "tell-tale" coulter, precedes the action of the shares, and is moveable to either end of the plough. The large coulter in the centre acts as a stay to steady the plough, and is also moveable in reversing the action. The attachment of the wire-rope to the plough at either end is connected with a set of bow springs, so that when anything obstructs the tell-tale coulter, and the traction consequently becomes greater, the rope is disengaged from the catch. A windlass at either end enables the attendant to regain the end of the wire rope.

I propose to cover the upper frame of the plough with boarding, having an iron railing round it to protect the attendant who travels with the plough. When the land is free from obstacles, instead of the bow-spring in the centre I have provided *spiral* springs at the angles for the attachment of the wire rope. The plough-frame is provided with wheels for locomotion, and is so constructed as to take to pieces when requisite.

This implement has the following advantages:—

1. The depth to which it effectually reverses the soil.
2. Its surface fulcrum.
3. Its working backwards and forwards without requiring to be turned round.
4. Its requiring no attendant to walk with it.

AUGUSTUS D. LACY.

NOTES AND NOVELTIES.

LIMITED LIABILITY.—The importance of the question of legally limiting the liability of persons associated together and subscribing capital for effecting objects of public or private benefit, when such operations, involving large outlay, are, for the most part, beyond the means of individuals, is well understood, as was shown by the passing of the Limited Liability Act last year; and although that step was in the right direction, it fell short of public requirements, and was practically inoperative.

The main question involved in the consideration of the subject was, whether or not the creditor should be protected by the Act of Parliament, or be left to use proper precautions in credit-giving, and rely upon his own judgment, by the proper exercise of which he would become of sounder commercial habits, and so, in proportion, be commercially more successful. We are, therefore, glad to find, by the Government Bill recently printed, that this view has been adopted. The forms and mode of working under the Act have been much simplified, and we hope to see the Bill carried through Parliament without delay, it being, in our opinion, the most important Act brought forward during the present session, inasmuch as it will operate beneficially in giving to the small capitalist safe and profitable employment for his money in aiding the inventor and ingenious mechanic in developing his skill and talent. And we know of no more useful and beneficial application of associated capital where the extent to which each subscriber is liable shall have been clearly defined at the amount he has agreed or undertaken to subscribe for.

Much as the amendment of the Patent Laws has done for the inventor, the reform in the laws relating to partnerships, and defining of the liability of subscribers to joint-stock companies, will do vastly more, by enabling him more readily to obtain the "*Sinews of War.*"

TRIAL OF THE "MARLBOROUGH."—Mr. Andrew Murray, Chief Engineer of the Steam Establishment in Portsmouth Dockyard, went out on the 20th ult. to direct the trial of the machinery of the *Marlborough*, new screw three-decker, 131 guns, 4,000 tons, and Mr. Shirref, manager of the firm of Mandslay and Field, went to note the result for the contractors. The engines are horizontal, having two cylinders 82 in. in diameter, with 4 ft. stroke; they have six boilers and twenty-four furnaces; the tube surface of the boilers is 17 ft. per H.P.; her screw is 9 ft. diameter, and 26 ft. 6 in. pitch. The engines made fifty-one and a half and fifty-two revolutions, with a pressure of 20 lbs. of steam. Her nominal H.P. is 800, but she worked up to 2,700. The weight of the machinery is about 600 tons. We are glad to say the trial was very satisfactory. Mr. Murray also made a trial of her speed, at the measured mile, in Stoke's Bay. In spite of the high wind she made the first run in 5 min. 1 sec., giving a speed of 11·960 knots, with the tide; the second run gave 10 knots, against the tide; the third run gave 12·162 knots, with the tide; and the fourth run gave 9·917 knots, against the tide—the mean average of the four runs realising 11·060 knots per hour. When properly trimmed, and under fair wind and weather, her speed will average from $11\frac{1}{2}$ to 12 knots per hour.

YARROW DOCKS.—The embankment of the Yarrow Docks is being progressed with by the contractors, and in the course of about three weeks seventy acres of the slake will be enclosed. Of the river wall there is about 500 yards constructed. The mason's work of the six jetties, leading to the docks, are also progressing rapidly towards completion, and about one-half of the lines of railway are finished. There are also about 100 men at work, diverting the channel of the river Don.

IMPROVEMENTS AT THE PRESTON RAILWAY STATION.—The Directors and Managers of the London and North Western and Lancashire and Yorkshire Railway Companies have erected a covered passage from one side of the station to the other, in consequence of the numerous accidents which have occurred to persons while crossing the lines. The passage is approached from each side by flights of stairs, constructed in such a manner as to render them easy of access to the public. It is lighted from the roof. The south-west end of the station has been enlarged about 50 yards, and now extends the full length of the iron roof. A large and commodious goods warehouse has also been erected, to meet the increasing traffic.

THE GENERAL SCREW STEAM SHIPPING COMPANY.—Rumour, with its thousand tongues, has long been busy with the affairs of this Company. The sale to the French Company has been styled *a dodge* to get rid of the small shareholders, who, it is said, were thought troublesome. Certainly, to the uninitiated in the mysteries of working our joint-stock companies and the share market there might appear some grounds for such observations, as the "Société Générale des Clippers Français" has been so recently brought before the British public, and has something of the appearance about it of being at least an off-shoot of the General Screw Steam Shipping Company, having, moreover, possessed themselves of eight of the finest vessels built by the General Screw Company—viz., the *Jason, Golden Fleece, Indiana, Calcutta, Argo, Queen of the South, Hydaspes*, and *Lady Jocelyn*.

NOTICES TO CORRESPONDENTS.

J. LIDDLE, *Quilon*, E.I.—Your inquiry was received too late to enable us to reply this month.

R. MONTGOMERY.—Appold's centrifugal pumps are made by Messrs. Easton and Amos, Grove, Southwark. They are not patented. Of Adcock's rotary pump, and "spray" pump, we cannot give you any information that would be of service; the last we saw of his rotary pump was some six or seven years ago, at the Walton station on the South Western Railway, when we examined and tested it; and, if we recollect aright, advised its removal. Of the spray pump we have not heard for some years; they were tried in a colliery up-cut-shaft, upon the estate of Mr. Blewett, M.P., but failed to effect any advantage over the common rude lift-pumps used for pit draining, but you may possibly learn all particulars required by applying to — Tyas, Esq., Banker, Doncaster, or George Liddle, Esq., Doncaster, who used to have some interest in the patents. As to Gwynne's centrifugal pumps, as also their semi-rotary pumps, we have used them extensively for various purposes; we have sent them out for Colonial use, in every case giving entire satisfaction. The other pump you refer to must be Parsey's rotary pump. As to hydraulic rams, write to W. F. Roe, of the Strand, or some other well-known maker.

ROKEBY.—We do not understand your first query, as to Colonial fibre; inform us of the kind of leaf, how long, &c.—how many crops per annum can be raised. The New Zealand flax (*Phormium tenax*) gives a very long silky fibre; but we think that, notwithstanding its length, strength, and soft silky nature, it was found liable to rot when the wet got into the body of the rope, and that Stockholm tar had an injurious effect upon it. It was, doubtless, for that reason that a solution of india-rubber was prepared and tried as a substitute for tar in making up the yarns into strands. A splendid ropery and spinning mill, together upwards of a quarter of a mile in length, were built on the fore-shore of the river Humber, at Great Grimsby, Lincolnshire, somewhere about the year 1834, by Capt. G. Harris, R.N., and his partners. This factory was worked for some years without success; nearly all the partners were ruined. So highly was the New Zealand flax held in estimation at the time of its introduction, that it was thought it would drive Manilla and the better hemps out of the market, and several law suits were commenced respecting the right to use both the flax and the india-rubber solution. Messrs. Enderby, of East Greenwich, if we remember aright, used the New Zealand flax for sail-cloth, rope-making, &c. We do not know if there is any importation of it now. It was said that the supply wholly or partially failed shortly after the starting of the Grimsby works, in consequence of the missionaries having a strong dislike to being paid, for the spiritual consolation they retailed, in the iron penny-pieces, glass beads, gunpowder, knives, hatchets, and damaged Manchester goods taken out by the merchants to barter with the natives for flax, so that the fleet sent out for the supply of flax found the missionaries there, and of course the condition of things materially altered since the previous visits. There are various Indian fibres, apparently excellently suited for ships' rigging, &c., if cultivated properly. We do not know that we can give you any further information, but if you still require more upon the subject we will send you, through post, the names and addresses of those who can furnish you, provided you enable us to do so by forwarding your address.

R. HUNT.—We do not remember seeing any quartz crushing mill, by "Mr. Hill, a London Engineer." During the California and Australian gold fevers, there were dozens of schemes. Write to Mr. Walker, City Road; Deane, Dray, and Co., Swan Lane, Thames Street; or Burgess and Key, Newgate Street, London. They will tell you what they have supplied.

R. HOW.—Yes; we have seen it, and were much disappointed. The boiler is long and low, the frame and adjacent parts are well constructed. There are some ingenious contrivances connected with it, but we have no hesitation in stating the engine would not run a dozen miles without becoming disabled; there are many parts about the working gear very badly proportioned, and injudiciously arranged. We advised that permission should be obtained to put it upon *Punch's* celebrated *clothes line*—the Kensington Railway—where a trial might be made; and, in case of failure, but little damage could be done, or injury to the *traffic* of the line ensue; for, without a practical test, the engine would, if sold, only fetch old metal price; if as successful as Mr. Ritchie anticipates, it would realise something approaching the value of its power. You may see the engine at Ritchie's works (an old pottery) at the foot of Kew Bridge.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATION FOR PATENTS AND PROTECTION ALLOWED.

Dated 17th January, 1856.

131 J. Platt and J. Whitaker, Oldham—Machinery for doubling or twining yarns or threads, parts of which improvements are also applicable to mules for spinning.

Dated 21st January, 1856.

161. G. A. Blittkowski, New York—Repeating fire-arms.

Dated 23rd January, 1856.

181. J. Hopkinson, jun., Huddersfield—Apparatus connected with steam-boilers.

Dated 24th January, 1856.

195. J. A. Longridge, Fludyer-st., Westminster—Construction of ordnance and other vessels intended to resist internal pressure, and in the manufacture and method of discharging projectiles.

Dated 25th January, 1856.

201. G. G. Woodward, Kidderminster—Manufacture of carpets.

Dated 28th January, 1856.

223. H. Hilliard, Glasgow—Articles of cutlery and apparatus for sharpening and cleaning the same.

Dated 1st February, 1856.

277. P. A. Le Comte de Fontaine Moreau, 39, Rue de l'Echiquier, Paris—Saponification of fatty matters.

Dated 2nd February, 1856.

291. G. Napier, Bath-st., Glasgow—"Breaks" for railway carriages.

Dated 8th February, 1856.

337. T. Restell, New Kent-rd.—Breech-loading and revolving fire-arms and cartridges.

Dated 13th February, 1856.

363. J. Mills, Oldham—Slide-valves.

Dated 21st February, 1856.

447. J. D. Greene, Craven-st., Westminster—Breech-loading fire-arms.

Dated 1st March, 1856.

525. W. Crozier, Sunderland—The better extinction of fire, street watering, &c.

Dated 11th March, 1856.

588. J. Collins, Birmingham—A machine for pulverising, crushing, pressing, and cleaning land.

Dated 13th March, 1856.

606. C. Duckworth and T. Marsden, Manchester—The manufacture of a new or improved woven fabric.

Dated 22nd March, 1856.

684. W. H. Barlow, Midland Railway, Derby—Covering and constructing bridges, viaducts, floors, and other structures, when iron is used.

Dated 24th March, 1856.

693. P. Brown and G. Brown, Liverpool—Sizing and stiffening textile materials by the application of new materials.

Dated 28th March, 1856.

748. S. Getley, 6, Ivy-st., Birkenhead—Supplying and drawing water to and from cisterns.

Dated 29th March, 1856.

752. A. Sands, Manchester—Securing rails in railway chairs, and in the construction of railway chairs.

754. J. Swyney, Massachusetts, U.S.—Breech-loading magazine fire-arms.

756. J. J. Rippon, Oakenshaw Print Works, near Accrington—Rollers or cylinders for printing fabrics.

758. J. Eives, 17, Cornhill—A new mode of preparing fibres from plants.

760. H. N. Penrice, Capt., R.E., Newcastle-upon-Tyne—Machinery for driving galleries through rock and other strata.

762. C. B. Normand, Havre—Steam-boilers, apparatus for applying heat to steam-boilers, and economising heat of furnaces.

764. C. D. Gardissal, 10, Bedford-st., Strand—Steam-boilers.

765. A. Guido, Versailles—Cleansing wool and woollen fabrics.

766. C. D. Gardissal, 10, Bedford-st., Strand—A new compound of inflammable materials for the purpose of lighting fires in grates, &c.

767. C. D. Gardissal, 10, Bedford-st., Strand—Screw stop-valves.

Dated 31st March, 1856.

769. J. Hicks, Piddle Trenthide, Dorset—Stoves.

770. B. Looker, jun., Kingston-upon-Thames—Mark or indicator to be let or fixed into the ground in burial-grounds and other places.

771. C. Jean le Mélorel de la Haichois, 39, Rue de l'Echiquier, Paris—Paving.

772. H. Henderson, Glasgow—Stop-cocks or valves.

773. C. Parker, Dundee—Machinery or apparatus for winding yarns or threads.

774. G. Bird, Glasgow—Application of asphaltic or bituminous compositions for building and structural purposes.

775. T. W. Burrell, Fareham—Machinery for obtaining power by water.

776. H. Cornforth, Birmingham—Manufacture of plated tea-pots, &c.

777. A. Prince, 4, Trafalgar-sq.—Regulating the elasticity of steel pens.

778. G. T. Smith, Northampton, and J. Watts, Battersea—Lubricator.

779. A. V. Newton, 66, Chancery-la.—Machinery for folding paper.

Dated 1st April, 1856.

780. J. Bentley, Liverpool—Breech-loading fire-arms, and cartridges to be used therewith.

781. C. Baptiste, Toulouse (France)—Machines for manufacturing tenons and mortices.

782. J. Ashton, Hyde Corn Mills, Hyde—Machinery for bruising grain or other matters preparatory to grinding.

783. A. Southam, S. Stead, and J. Martin, Manchester—Separating the vegetable substances from mixed fabrics, and rendering the vegetable substances available for manufacturing purposes.

784. A. L. A. Herbelot, Paris—Obtaining a continual motive-power.

785. E. Laporte, Paris—Manufacture of bougies, candles, &c.

786. J. Gray, Peckham—Steam-boilers, &c.

787. A. V. Newton, 66, Chancery-la.—Apparatus for ascertaining gradients.

788. W. Roberts, Millwall, Poplar—Pumps.

789. J. Paterson, Linlithgow—Manufacture of paper.

Dated 2nd April, 1856.

790. F. Grice, West Bromwich—Machinery for the manufacture of bolts and nuts.

791. F. Young, Norwich—Two-wheeled open vehicle.

792. R. Roberts, Manchester—Omnibuses and other passenger carriages.

793. P. M'Gregor, Falcon Works, Manchester, and T. Marquis, Huncoat, Accrington—Machines for spinning called "throstles."

794. J. S. Cottrill, Great Lever, Bolton—Presses.

795. C. Ellis, Stockport—Machinery for spinning and doubling cotton and fibrous substances.

796. G. B. Galloway, 42, Basinghall-st.—Propelling vessels.

797. L. Bonnard, Tottenham Court-rd.—Collapsible or folding hats and bonnets, and flexible articles to be applied to other coverings for the head.

798. G. Gwynne, Trafalgar-sq.—Treating fatty bodies.

799. H. G. Hine, Brecknock-st., Camden-town—"Perambulators."
800. H. Smith, Lee—Cleaning boots and shoes.
801. J. Samuel, Great George-st., Westminster, and J. Nicholson, Bow—Steam and other vapour engines.
802. A. V. Newton, 66, Chancery-la.—Construction of rotary steam-engines, applicable in part to pumps for raising and forcing fluids.

Dated 3rd April, 1856.

803. W. Jenkins, Neath Abbey—Method of manufacturing copper rollers for calico printing.
804. E. A. Pontifex, Shoe-la., and W. Needham, Vauxhall—Manufacture of preparations or primings used for preparing canvas, or other material, for the reception of pigments or colours.
805. C. C. Smith, Wolverhampton—Method for working breaks for stopping machinery used for raising coals and minerals, and for stopping steam-engines and other motive-power engines.
806. W. Billinton, Great George-st., Westminster—Strengthening and preserving wood and timber.
807. H. R. Abraham, Essex-house, Barnes—Improvements in passenger, exhibition, or delivery tickets or checks, and in the method of indicating and recording passenger traffic, or delivery of goods, and in the machines used as tell-tales for such purposes.
808. T. White, jun., Portsmouth—Slips and ways for receiving ships or vessels requiring repair, and apparatus to be used for hauling up ships.
809. F. W. Kitson, Leeds—Manufacture of railway wheels.
810. J. H. Glassford, Glasgow—Production of printing surfaces.
811. J. Bannehr, Exeter—Manufacturing paper for, and mounting copies of, written documents thereon.
812. J. Fernie, Forrester-st.. Derby—Hoists by combining steam and a hydraulic column.

Dated 4th April, 1856.

813. P. E. Chappuis, 69, Fleet-st.—Looking-glasses to render them double-reflective.
814. R. Halliwell, Bolton-le-Moors—"Self-acting mules."
815. C. D. Gardissal, 10, Bedford-st., Strand—Treatment of fabrics or textile materials to be dyed or printed.
816. S. Fisher, Birmingham—Manufacture of anchors, shafting for mill and engine purposes, axles, cranks, and spindles, and in the furnaces or muffles used in the said manufacture.
817. J. Roberts, Upnor, Kent—Manufacture of ornamental tiles.
818. C. W. Ramié, 73, Denbigh-st., Pimlico—Constructing the permanent ways of railways.
819. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Moulding planes.

Dated 5th April, 1856.

821. J. Jones, Warrington—Railway chairs, and method of securing the rails to the same.
822. J. Hogg, South Blacket-pl., and J. Napier, East Sciennes st. Edinburgh—Stereotyping.
823. O. Blake, Thames Plate Glass Works, Blackwall—Manufacture of glass.
824. B. Kisch, Kennington—Apparatus for containing an arrangement of cards or papers for selection.
825. J. Webster, Birmingham—Elastic metallic tube, and method of manufacturing the same.
826. T. R. Whitehead, Manchester—Garments or apparatus to be used for sustaining the human body in water, or for acquiring the art of swimming.
827. J. Bernard, Albany, Piccadilly—Machinery employed for manufacturing or making boots and shoes, or other coverings for the feet.
828. E. Martin, Oxford—Leg-guard.
829. H. T. Sturley, Church st. South Lynn—Compound or breakfast mixture.
830. A. Morton, Wakefield—Manufacture of paints and pigments.
831. W. Porter Maddison, Barnsley—Telegraph for the transmission of signals.
832. W. H. Moore, Wenlock-pl., City-rd.—Manufacture of candles.
833. F. G. Underhay, 13, Wells-st., Gray's-inn-rd.—Apparatus for drawing off water.
834. H. Craigie, Edinburgh—Heating apartments where gas and water are used.
835. J. Betteley, Liverpool—Manufacture of iron for knees for ships or other purposes.

Dated 7th April, 1856.

837. J. Smith, 9, Union-ct., Old Broad-st., J. Luntley, 3, New Broad-st.-ct.—Treating the sunflower plant to render its fibres applicable to the manufacture of textile fabrics, paper, yarn, cordage, &c.
838. J. Leigh, Manchester—Use or application of a certain substance or substances in the sizing, or otherwise preparing cotton, or other yarns and fabrics.
839. E. Morris, Bergen, U.S.—Machinery for raising and lowering weights.
840. W. E. Newton, 66, Chancery-la.—Construction of furnace for the manufacture of glass.
841. C. D. Gardissal, 10, Bedford-st., Strand—Preparing various resins and combining them with oils and fatty matters for manufacturing candles thereof.
842. A. Morton, Wakefield—Manufacture of paperbangings for decorative purposes.
843. W. Terry, Birmingham—Breech-loading fire-arms.
844. W. C. Fuller, 2, Bucklersbury, Cheapside—Constructing and adapting india-rubber as tyres for wheels.
845. J. Adams, 11, Grosvenor-st., Belgrave-gate, Leicester—Knitting machinery.
846. W. H. Gauntlett, South Bank Iron Works, Eston Junction, Middlesbro'-on-Tees—Thermometric apparatus.
847. J. Graves, London, and W. F. Henson, Hampstead—Lubricating carriage and other axles.

Dated 8th April, 1856.

848. S. J. Gold, Newhaven, U.S.—Apparatus for warming buildings by steam.
849. J. C. Bowser, Queen's-ter., St. John's-wd.—Glove fastenings.
850. A. C. L. Devaux, King William-st., City—Construction and the fitting up of granaries.
851. W. E. Newton, 66, Chancery-la.—Process of manufacturing steel, and carbonising iron and the ores thereof in the said manufacture.
852. W. J. Curtis, 1, Sebbon-st., Islington—Lubricating the axles of locomotive-engines and of carriages on railways.
853. J. A. Ransome and G. A. Biddell, Ipswich—Manufacture of railway bars and flanch bearers of railway crossings.
854. J. Brooke, 10, Crescent, Jewin-st.—Lift pumps.

Dated 9th April, 1856.

855. J. Gedge, 4, Wellington-st. south, Strand—Treatment or preparation of leather, and the manufacture of articles composed thereof.
856. J. R. Whitgreave, Rugeley—The arrangement and construction of locomotive-engines.
857. H. Laxton, 19, Arundel-st., Strand—Apparatus for increasing the buoyancy of ships and other vessels.
858. R. Chrimes, Rotherham—Buffers and other springs for railway and other carriages.
859. J. Armour, Kirkton Bleach Works, Renfrew—Bleaching textile fabrics and materials.
860. G. F. Morrell, Fleet-st.—The manufacture of railway chairs.

Dated 10th April, 1856.

861. H. Laxton, 19, Arundel-st., Strand—Mode of adjusting circular saws.
863. A. V. Newton, 66, Chancery-la.—Means of attaching together or securing sheets and pieces of paper or manuscript documents.
864. W. Hall, Erith—Stopping or retarding the way of ships and vessels, in order to prevent collisions and otherwise.
865. G. Homfray, Ruabon—Furnaces.

Dated 11th April, 1856.

866. H. Henderson, Glasgow—Water-closets.
867. T. W. Makin, Longsight, Manchester, and J. Barnsley, Stockport—Machinery for embossing moiré antique water on all kinds of woven fabrics.
869. J. Burnside, 43, Henry-st., Sunderland—Apparatus for propelling and steering ships and boats.
870. P. A. le Comte de Fontaine Moreau, 39, Rue de l'Echiquier, Paris—Apparatus for measuring the speed of currents of air and water.
871. G. Jackson, Bilston—Steam-boiler, to be heated by the waste heat of puddling or mill furnaces.
872. R. Davis, 267, Oxford-st.—Construction of tobacco-pipe stems.
873. A. Perpigna, Paris—Manufacture of coke.

Dated 12th April, 1856.

874. J. Nash, Manchester—The fusible plugs and furnaces of steam-boilers.
875. L. Schultz, Green-st., Stepney—Obtaining photographic pictures upon paper, glass, metal plates, and other fibrous substances.
876. R. S. Newall, Gateshead-upon-Tyne — Telegraphic insulators.
877. W. B. Flint, Birmingham—Fasteners for shutters, doors, and such like purposes, and which said fastening is also applicable to the coupling of railway carriages and trucks, and other useful purposes.
878. F. Nuibo y Pedros, 39, Rue de l'Echiquier, Paris—Motive-power.
879. R. B. Lindsay, Mill Wall Brewery, Poplar—Removing the scale or deposit from tubular flues of steam-boilers.

Dated 14th April, 1856.

880. E. Heywood, Sutton, near Keighley—Fixing apparatus for generating steam, whereby smoke will be prevented or consumed, and fuel economised.
881. G. Braden and C. Braden, Sharp's-al.—Manufacture of show tablets for advertising purposes.
882. P. Robertson, Shawland's-hill, Renfrew—Power-loom weaving.
883. J. Symonds and T. M. Fell, Sufferance-wharf, Millwall, Poplar—Reduction of gold, silver, & other ores.
884. R. Richardson, Great George-st., Westminster—Railway switches.
885. G. Davies, 1 Serle-st., Lincoln's-inn—Method of soldering or uniting cast-iron.
886. L. P. Coulon, 39, Rue de l'Echiquier, Paris—Type distributing and composing machine.
887. J. Bridgwood, Burslem—Manufacture of china and earthenware plug wash-hand basins.
888. J. Barrans, New-cross, Deptford—Constructing steam engines.
889. S. Cunliffe Lister, Bradford—Spinning.
890. W. Warren, Northampton-park, and W. de la Rue, Bunhill-row—Manufacture of envelopes.
891. S. Cunliffe Lister, Bradford—Weaving.
892. L. Kaberry and A. Horsefield, Rochdale—Moulding for casting certain parts of machinery used in the preparation and spinning of cotton and other fibrous materials.
893. A. V. Newton, 66, Chancery-la.—Machinery for felting hat bodies.
894. A. V. Newton, 66, Chancery-la.—Mode of constructing grate-bars.

Dated 15th April, 1856.

895. H. F. Forbes, Park-pl., Regent's-pk.—Breech-loading fire-arms and ordnance, and projectiles used therewith.
896. W. H. Olley, 2, Brabant-ct. Philpot-la.—Taking photographic impressions or pictures of microscopic objects by reflection, such reflection being effected by the combined aid of the microscope and camera obscura and camera lucida, or other reflectors that may be employed in place of the latter.
897. W. Smith, Aston, near Birmingham—Manufacture of steel wire for musical and other purposes.
898. T. Jeffries, Reading—Cooking-stoves.
899. E. R. Southby, Bulford, Amesbury, Wilts—Coating iron with copper.
901. J. Demain, Markington, York—Connecting railway carriages.
902. W. Fuller, Jermyn-st.—Ice pails.

Dated 16th April, 1856.

903. W. Routledge, Salford—Construction of steam-engine and other boilers to prevent explosions.
904. E. N. Norminton, 12, Charrington-st., St. Pancras—Manufacturing of railway grease, cleansing and remanufacturing of old used dirty railway grease, for the cleansing and remanufacturing of old dirty cotton waste, tow, or any textile fabric.
905. F. Priestley, Cleveland-st., Fitzroy-sq.—Pianofortes.
906. D. Blair White, M.D., Newcastle-upon-Tyne—Cylinder pistons or plungers.
907. T. Mellodew and J. Duxbury, Oldham—Shuttles for weaving.
908. A. V. Newton, 66, Chancery-la. — Fire-arms and powder-flasks.
909. W. E. Newton, 66, Chancery-la.—Apparatus for raising sunken vessels and increasing the buoyancy of floating vessels.
910. J. H. Johnson, 47, Lincoln's-inn-fields — Cleansing and hulling grain and seeds, and the machinery employed therein.
911. W. Armitage and H. Lea, Farnley Iron Works, Leeds—Manufacture of iron.
912. W. Little, Strand—Lamps for burning paraffine and bituminous oils or naphthas.
913. W. Wilkinson, Hull—Steam-engines.

Dated 17th April, 1856.

914. C. Hulme, S. Ivers, and J. Yardley, Farnworth—Power-looms for weaving.
915. H. Y. D. Scott, Capt., R.E., Brompton Barracks, Chatham—Mode of manufacturing cement.
916. J. H. Johnson, 47, Lincoln's-inn-fields—Manufacture of tyres.
917. L. Mesure, Billericay, Essex—Watches.
918. S. Eyre, Bouverie-st.—Application of portable mirror.
919. J. Luntley, Broad-st.—A new fabric suitable for wearing apparel and other purposes to which textile fabrics are applicable.
920. J. S. Wright, Birmingham—Construction and ornamentation of belt or band fastenings.

Dated 18th April, 1856.

921. G. Lurig, Adelebsen, Hanover—Process of manufacturing saltpetre.
922. W. Westley, Willington, Derby—Nail or spike.
923. W. Tytherleigh, Birmingham—Improved method of coating or covering iron or articles of iron with copper or alloys of copper.
924. J. Marsh, Burnt Tree, near Dudley—Fire-grates.
925. W. Budden, Ipswich—Method of preparing cheques, invoices, and other papers, so that they may be readily separated from their counterparts.
926. C. F. Stansbury, 67, Gracechurch-st.—Mode of splicing and fastening the adjacent ends of the rails of a railway track.
927. T. Hollingworth, Turkey Mill, near Maidstone—Machinery for dusting or cleaning rags.
928. U. Scott, Camden-town—Metal fittings for furniture.
929. E. V. Gardner, 24, Norfolk-st., Middlesex Hospital—Furnaces.
930. T. Walker, Birmingham—Governors or regulators of steam and other motive-power engines.
931. G. Thompson, Marchmont-st., Russell-sq.—Improvements in instruments or apparatus used in drawing or marking with crayon, "black lead," or other such materials.
932. J. Jeffreys, Kingston-hill — Instruments for aiding respiration.
933. P. W. Barlow, Great George-st., Westminster—Seasoning timber.
934. J. G. Jennings, Great Charlotte-st., Blackfriars-rd.—Pumps.

Dated 19th April, 1856.

935. C. Moret, 39, Rue de l'Echiquier, Paris—Rotary steam-engines.
937. T. Blackburn, Brighouse—Preparing for spinning cotton waste and silk waste.
938. E. Hunt, 31, Walnut-tree-walk—Hansom cabs and similar vehicles, parts of which improvements are also applicable to other carriages.
939. C. F. Stansbury, 67, Gracechurch-st.—A new instrument for determining the position and bearing of ships at sea.
940. W. Adkins, Smallbrook-st., Birmingham—Measuring fabrics, which he proposes designating "The Automaton Measurer, or Draper's Assistant."
941. T. Wilkes, Birmingham—Manufacturing tubes of copper and alloys of copper.

942. W. J. J. Varillat, Rouen—Apparatus for the extraction of colouring, tanning, and saccharine matters from vegetable substances.
943. R. Hazard, 1, Thanet-pl., Strand—A heat extractor for extracting the heat from the smoke or heated gases in its passage from boilers, stoves, or furnaces to the chimney, and rendering the economised heat available for drying and warming purposes.
944. A. Longbottom, Moorgate-st.—Means of lighting and ventilating mines.
945. W. Crosley, 16, Westbourne-park, and G. Goldsmith, Leicester—Wet gas meters.
946. F. J. Bouwens, Malines, Belgium—Rotative steam-engine.

Dated 21st April, 1856.

947. P. Heyns, Poplar—Railway wheels.
948. J. Nasmyth, Patricroft, Manchester, and H. Minton, Stoke-upon-Trent—Machinery employed in manufacturing tiles and other articles from pulverised clay.
949. S. Mellor, Salford, and T. Young, Manchester—Machinery for supplying water to steam-boilers.
950. J. Dortet, Paris—Padlock.
951. W. Owen, Lincoln's-inn-flds.—The modes of attaching buttons to wearing apparel.
952. J. A. M. T. Chambor, Paris—Fire-places.
953. W. Maugham, Ifield-ter., Stockwell—Preparation of starch.
954. J. Hansor, 2, Portland-pl., Wandsworth-rd.—Manufacture of illuminating gas.

Dated 22nd April, 1856.

955. W. J. Cantelo, Southwark—Preservation of vegetable matters.
956. J. T. Stroud, Suffolk-st., Birmingham—Stop-cocks for regulating or cutting off the passage of gas to combined gas burners.
957. A. Symons, George-st., Mansion-house, and E. Burgess, Clerkenwell-grn.—Instruments for ascertaining and indicating heat, and also the parts for making and breaking contact in electric circuits used therewith.
958. A. Symons, George-st., Mansion-house, and E. Burgess, Clerkenwell-green—Apparatus for producing alarums to indicate burglary by means of electricity.
959. A. S. Vimont, Vire (Calvados) France—A new system of machine for spinning wool and any other fibrous material.
960. A. V. Newton, 66, Chancery-la.—Obtaining purified oil from coal and other bituminous substances.
961. P. Brown and G. Brown, Liverpool—Apparatus applicable to furnaces or stoves, for the purpose of economising fuel and heat.
962. W. Smith, Woolston, Fenny Stratford—Constructing and applying windlasses for working ploughs and other agricultural implements.
963. C. Nickels, Albany-rd., Camberwell, and J. Hobson, Leicester—Machinery for weaving carpets and terry fabrics.
964. D. Lloyd, Ebbw Vale Iron Works, South Wales—Washing minerals, coal, and ores.
965. T. Jeacock, 20, Bridge-st., Leicester—Knitting machinery.
966. T. E. Blackwell, 1, Cornwallis-grove, Clifton—Treating water for the use of brewers.
967. W. G. Armstrong, Newcastle-upon-Tyne—Apparatus for lifting, lowering, and hauling.
968. R. A. Brooman, 166, Fleet-st.—Centrifugal machinery.

Dated 23rd April, 1856.

970. G. Forster, Standish, Wigan—Arrangements of "trap-doors" or "air-doors," and their cases in the workings or passages in mines, whereby the efficient ventilation is maintained, which said improvements are also applicable in other similar situations.
971. A. Bullough, Blackburn—Looms.
972. J. Garnett, Low Moor, Clitheroe—Twisting, winding, and reeling yarn, and in machinery employed therein.
973. W. P. Savage, Roxham—A machine for drilling and rolling land.
974. T. Squire and C. F. Claus, Latchford — Artificial manure.
975. J. S. Perring, Radcliffe—Chairs for railways.
976. W. H. Balmain and T. Colby, St. Helen's—Manufacture of alkalies from their sulphates.
977. J. Barbour, Glasgow—Sawing apparatus.
978. P. Ward, Patent Alkali Works, St. Helen's—Furnaces used in the manufacture of alkali.
979. D. Brown, Smethwick—Method of joining the rails of railways.

Dated 24th April, 1856.

981. A. D. Schratz, Saint Denis, near Paris—Preparing colours for the impression of woven or textile fabrics or stuffs.
982. J. Yeomanson and W. Yeomanson, Leicester—Knitted fabrics.
983. T. Woodcock and J. K. Punshon, 26, Great Ormond-st.—Machine for cutting and slicing bread and other substances.
984. G. Ashworth, Sunny Bank Mills, Rochdale—Machinery for preparing slivers or slubbings of wool and other fibrous materials, commonly called condensing carding engines.
985. C. Cowper, 20, Southampton-bldgs., Chancery-la.—A new yarn or thread, and its application in the manufacture of stockings, gloves, and looped and other fabrics.
986. F. Allman and D. Bethune, Cambridge-terr., Hyde-prk.—Apparatus for the production of steam, and the apparatus employed in its application to motive purposes.
987. V. Doat, Albi, France—Galvanic battery and method of recovering and revivifying the agents employed.
988. W. Neilson, Glasgow—Locomotive-engines.
989. F. W. Blacket, West Smithfield—The construction of keys and locks, and the fitting of locks, to afford increased safety.
990. T. Moore, Retford—Machinery for riddling and winnowing or cleaning corn and other grain.

Dated 25th April, 1856.

991. W. Naar, Glasgow—Folding or adjustable articles of furniture.
993. J. Hardacre, Manchester—Arrangement and construction of carriages and carriage-wheels.
994. C. Swift and J. J. Derham, Blackburn—Steam-engines.
995. I. D. Fraétaniel, Paris—Safety rein or bridle.
996. W. Gossage, Widness, Lancaster—Sulphuric acid.

Dated 26th April, 1856.

998. T. Hill, Heywood, Lancaster—Steam-boilers and furnaces.
999. T. Lawes, 32, City rd.—Construction and manufacture of an implement used in tilling the land.
1000. E. Topham, Mansfield-rd., Nottingham—Apparatus for cleansing out the sediment from the water in steam-boilers and preventing incrustation.
1001. M. W. Hilles, Percy-st., Bedford-sq. — Apparatus applicable to the treatment and cure of rupture, prolapsus uteri, and other protrusions of the viscera.
1002. W. E. Newton, 66, Chancery-la.—Machinery for manufacturing painted or enamelled cloth.
1003. C. A. Arnaud, Lyons—Obtaining motive-power from steam and other fluids, and in pumping and forcing water and other fluids.
1004. T. Walker, Warwick-pl., Pimlico—Playing cards.
1005. A. Vacherot, Paris—Construction of submarine tunnels.
1006. T. Heiffor, Sheffield—Razor-blades.

Dated 28th April, 1856.

1007. G. Napier, Bath-st., and J. Millar, Cavendish-st., Glasgow—The manufacture of gas from coal, tar, or other bituminous, resinous, or fatty matter.
1008. J. C. B. Dubos, Paris—Electro-magnetic apparatus.
1009. T. Restell, New Kent-rd.—Fittings or appendages for doors, and the means of fixing or attaching the same.
1010. H. Geering, Birmingham—Metallic bedsteads, chairs, couches, and other articles for sitting, lying, or reclining upon.
1011. W. D. Ruck, Topping's-wharf, Tooley-st.—Tanning hides and skins.

Dated 29th April, 1856.

1012. C. J. Graftiaux, Molenbeck St. Jean by Brussels—Rotary steam-engines.
1013. J. Hick, Bolton-le-Moors—Apparatus for equalising the temperature of the water in that kind of steam-boilers generally called multi-tubular boilers.
1014. J. S. Crosland, Openshaw, Manchester—Furnaces and steam generators for locomotive steam-engines and other purposes.
1015. T. Greenshields, 11, Little Titchfield-st.—Sleepers for railways.
1016. C. Fitterton, Roehampton—Manufacture of white zinc.
1017. T. Webster Rammell, Trafalgar-sq.—Pen and pencil holders.
1018. I. A. Boss, Bury-st., City—Preparing cane, in order to render it suitable to be used as a substitute for whalebone.
1019. W. Pilling, Oldham—Treatment of yarns or threads, and the apparatus connected therewith.
1020. J. H. Johnson, 47, Lincoln's-inn-fields—Anchors.

Dated 30th April, 1856.

1021. J. Smith and W. Craven, Collyhurst, Manchester—Machinery or apparatus for dressing, machining, and finishing velvets, velveteens, and other fabrics.
1022. F. C. Spilsbury, Chaudfontaine, Belgium, and 56, Stones-end, Borough—Separating metals, metallic oxides, and metallic acids from their ores.
1023. S. Dyer, Bristol—Reefing, furling, and setting the sails of ships and vessels.
1024. J. Rigby, Ashton-under-Lyne—Machinery for grinding or sharpening the card cylinders and rollers of carding engines.
1025. L. J. B. Mancvy, Paris—Manufacturing cast steel.
1026. W. Jones, Pendleton—Apparatus for regulating the pressure and flow of steam, water, and other purposes.
1027. W. E. Newton, 66, Chancery-la.—Method of, and machinery for, polishing the surface of glass, stone, metal, or other materials capable of being polished by friction.

Dated 1st May, 1856.

1028. N. Defries, Fitzroy-sq., and G. H. Bachhoffner, Montague-st.—Gas fires.
1029. H. Mapple, Child's-hill—Barometers.
1030. W. E. Newton, 66 Chancery-la.—Phosphoric acid.
1031. C. Perron and V. Boulland, Paris—Knitting machine.
1032. S. Carey, Clink st. wharf, Bankside, Southwark — Water carts and barrows.
1033. R. A. Brooman, 166, Fleet-st.—Compressing, regulating the pressure and flow of, and conveying gas, parts of which are applicable to air and other fluid pumps.
1034. R. A. Brooman, 166, Fleet-st.—Machinery for felting or "planking" hat bodies.
1035. A. J. Paterson, Upper Eaton-st.—Hawsers and other ropes or chains used in towing vessels.
1036. N. Smith, Thrapston, Northampton —Clod-crushing rollers, parts of which are applicable to other descriptions of rollers.
1037. A. Smith, Wentworth-st.—Treating Vegetable fibres in order to fit them for use as a substitute for bristles in paint and other brushes.
1038. S. Hunter, 13, Ravensworth-ter. Gateshead—Anchors.

Dated 2nd May, 1856.

1039. J. Cowley, Quenington, Gloucester—Manufacture o paper from straw and other vegetable substances.
1040. R. Pearcy, Manchester—Machinery or apparatus for twisting cotton and other fibrous substances.
1041. W. Waite, 156, Cheapside—Construction of sleepers and rails for railways.
1042. W. Naylor, Norwich—Power hammers and rivetting machines, part of such improvements being applicable to the manufacture of bolts or rivets.
1043. W. Day, Campbell-rd., Bow-rd.—Clod crushers or rollers for ruling, pulverising, or pressing land.
1044. A. Gordon, Fludyer-st., Whitehall—Evaporating, boiling, and distilling fluids, and generating steam.
1045. H. E. Brown, 2, Summer-st. North, Dublin—Hinges denominated concealed hinges, for carriage doors and doors of every description.
1046. S. Rooke, Birmingham—Manufacture of stair-rods.
1047. R. A. Brooman, 166, Fleet-st.—Machinery for bending or shaping timber.
1048. H. A. Thomson, Lewes—Hay-making machines.
1049. R. T. Campbell, Washington, U.S.—Machines for reaping and mowing.

Dated 3rd May, 1856.

1050. P. A. le Comte de Fontaine Moreau, 39, Rue de l'Echiquier, Paris—Electric telegraphs.
1051. J. Wright and T. Gorrery, Sheffield—Railway carriage and other springs.
1053. H. Duncan Preston Cunningham, Gosport—Apparatus to be applied to boats to increase their buoyancy and stability.
1054. W. Garside, Vicar-st., Kidderminster—Method of letting off the worsted or yarn from the bobbins employed in weaving carpets, and other similar fabrics in which bobbins are employed during the manufacture thereof.

Dated 5th May, 1856.

1055. C. Bloomer, West Bromwich—The manufacture of spikes and bolts.
1056. G. Williams, 16, Cannon-st., St. George's-in-the-East—Fog and dark night alarm signals.
1057. W. Bulmer and I. Sharp, Middlesbro' —Manufacture of bricks, tiles, and other articles from plastic substances.
1058. I. Holden, St. Denis, Paris—Preparing and combing wool and other fibrous substances.
1059. A. Chadburn, Sheffield — Construction of pressure-gauge.
1060. W. Gregory, Old Church st. Paddington—Construction of roofing tiles.

Dated 6th May, 1856.

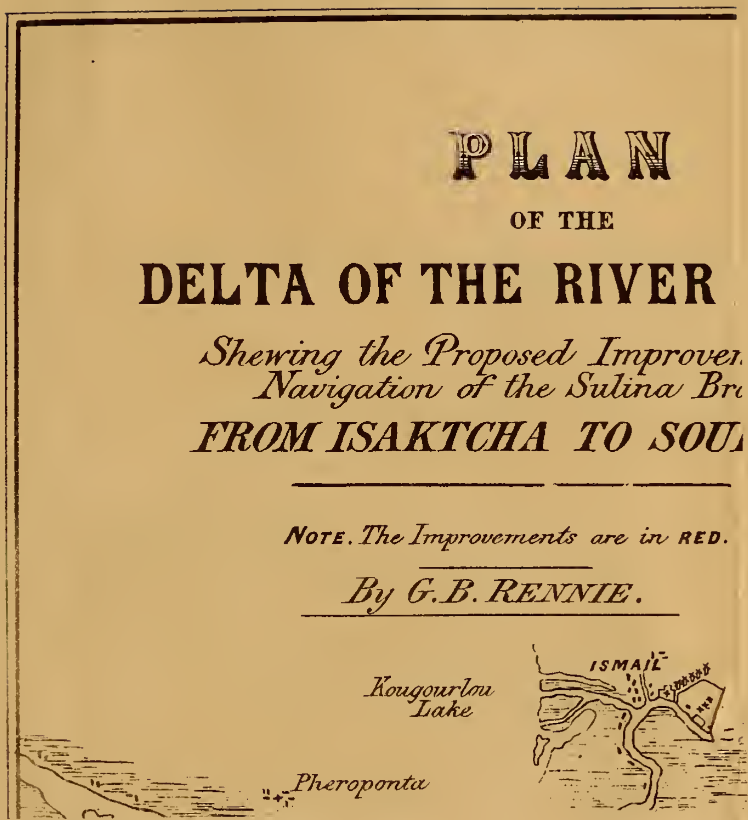
1061. A. L. Beudant and J. L. M. P. Benoit, Paris—Treating ores of copper containing arsenic and antimony.
1063. J. Wright, Upnor, near Rochester—Apparatus for lowering ships' boats.
1065. W. E. Newton, 66, Chancery-la.—Apparatus for connecting boats with their tackle, and clearing or detaching them therefrom when lowered from on board ship into the water.
1067. T. Huckvale, Choice-hl., Chipping Norton — Implements for thinning and hoeing turnips and other crops.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

862. P. Bancroft, Edmund-st., Liverpool, and S. White, Bond-st., Liverpool—Manufacturing certain oils or oily substances obtained from the petroleum, commonly called earth oil, found in certain districts of the Birman Empire and elsewhere.—10th April, 1856.
868. L. Normandy, 67, Judd-st., Brunswick-sq.—Mode of writing and printing music to facilitate the study thereof.—11th April, 1856.
900. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton —Surface or fresh water condensers, chiefly applicable to steam-engines.—15th, April, 1856.

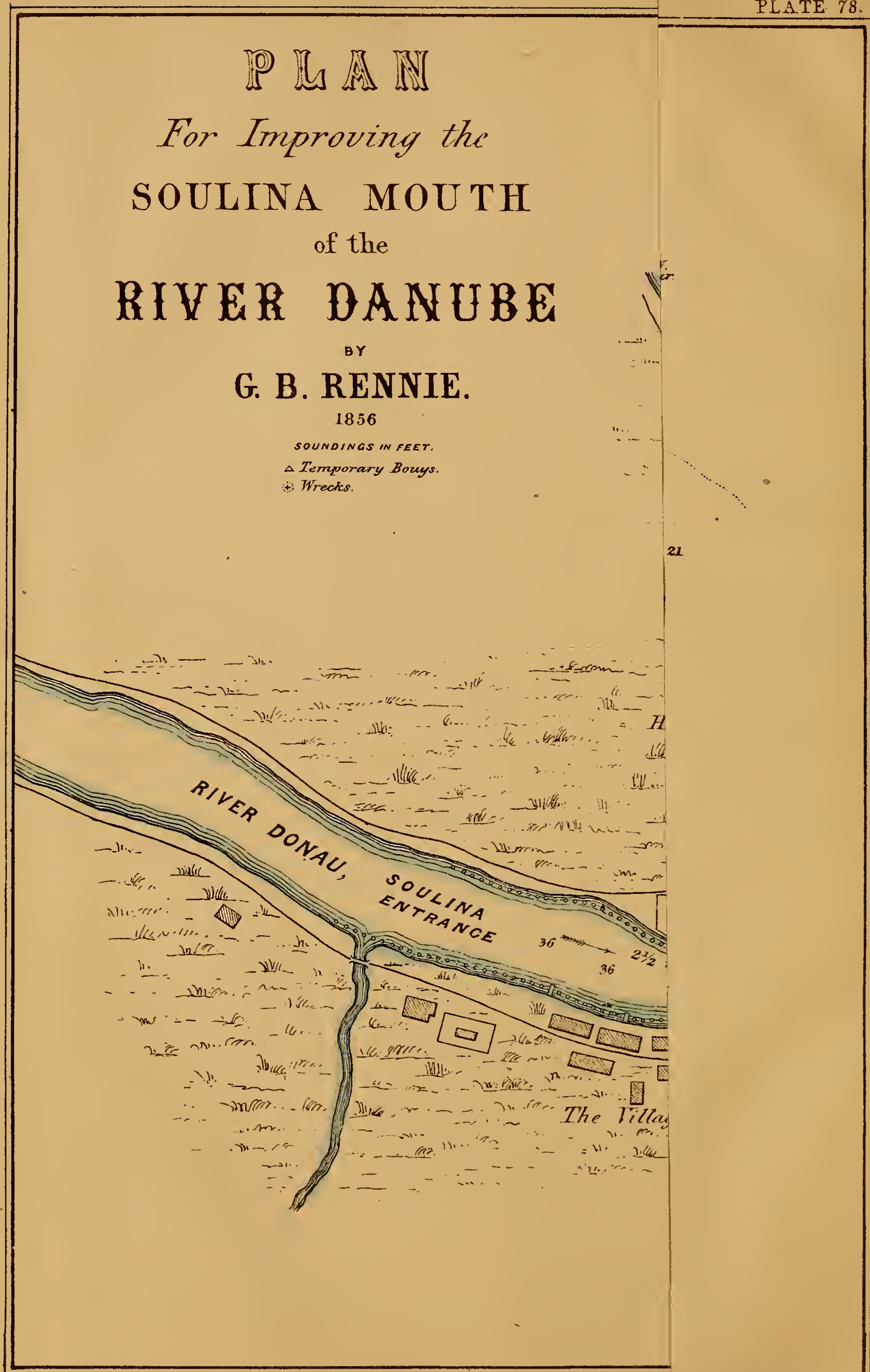
DESIGNS FOR ARTICLES OF UTILITY.

1856.
April 17. 3830. W. Sugg, 19, Marsham st. Westminster, "Parts of a Gas Governor."
„ 17. 3831. J. Palmer and Son, Camberwell, "Part of a Vesuvian Case or Box."
„ 29. 3832. R. Thompson, De Beauvoir Town, "Thompson's Pocket Protector."
May 6. 3833. J. M. Butt and Co., Kingsholm Iron Works, Gloucester, "Street Gully, or Stench and Sediment Trap."
„ 7. 3834. J. Cliff, Wortley, near Leeds, "Improved Invert Block for Sewer or Conduit Bottoms."
May 8. 3835. Silverwood and Marsh, Sheffield, "Brass-hound Square or Bevel."
„ 9. 3836. E. Wood, 6, Felix-st., Liverpool-rd., Islington, "E. Wood's Ever-pointed Receding Pencil."

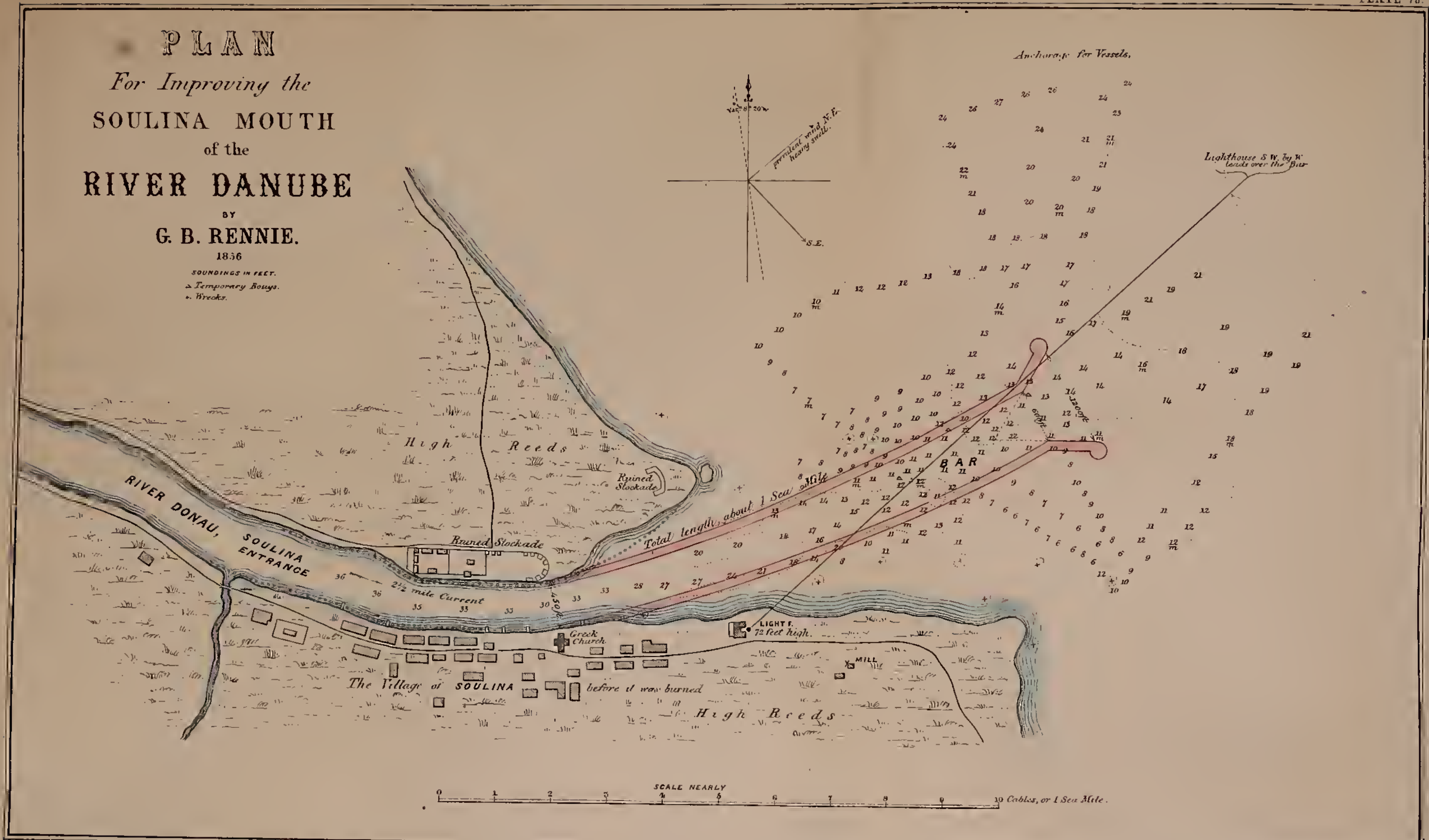

PLAN
OF THE
DELTA OF THE RIVER
Shewing the Proposed Improven
Navigation of the Sulina Br
FROM ISAKTCHA TO SOU
NOTE. The Improvements are in RED.
By G.B. RENNIE.
ISMAIL
Kougourlou Lake
Pheroponta


PLAN
OF THE
DELTA OF THE RIVER DANUBE
Shewing the Proposed Improvements of the Navigation of the Sulina Branch,
FROM ISAKTCHA TO SOULINA.
NOTE. The Improvements are in RED.
By G. B. RENNIE.
ISMAIL
Kougourlou Lake
Pheroponta
ISAKTCHA
Toushka
Kilia
Kilia Mouths
Ochakov Mth
Ankow Dinovo Mth
Sredniu Mouth
Stamboul Mth
Skagonskie G.
Koundouk Lake
Galldeshtic
Jibrians
LETTI Id
CHETAL Id
Toultcha
Toutma
Soulina Mth
Light F. 72ft
Besh Tepeh
MOISH Id
Popin I.
Raselm Lake
Monastery
DRANOVA Id
St George's Mth
Fishing Huts
BULGARIA
Jourilouka
Portitskoe Mth
Varn G. 25 W.
Fidonisi Light R. 200 ft. high

PLATE 78.



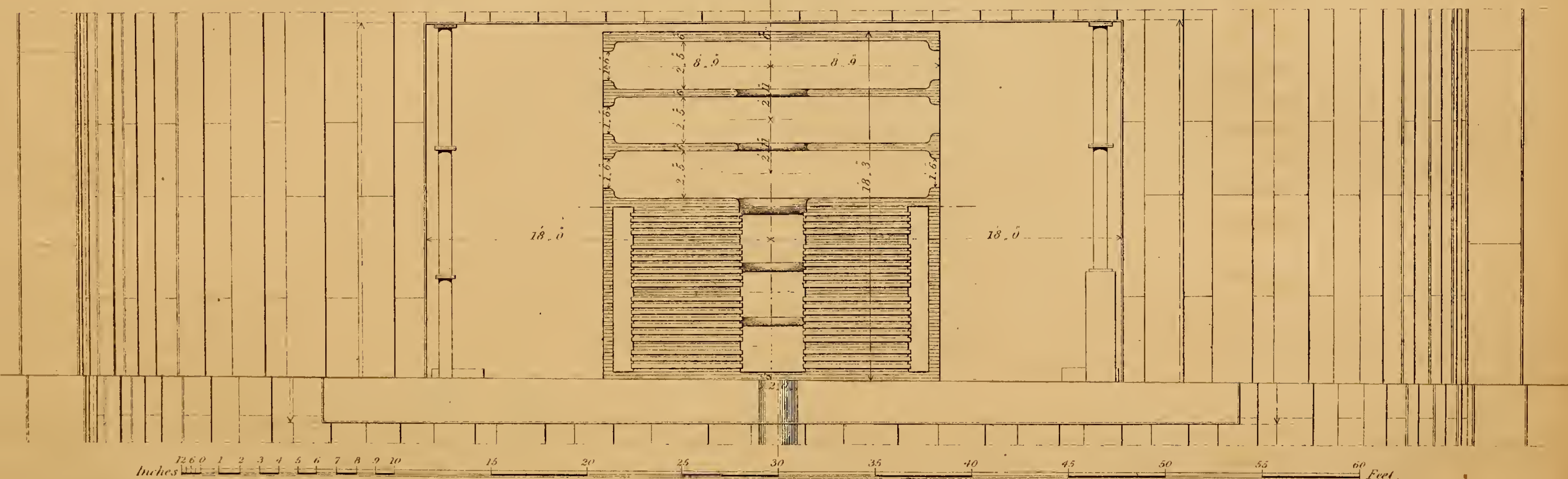
W. Smith, C.E. direx[t] ...d._ Artizan Office, 1856.



Engraved _ Artizan Office, 1856.

THE EASTERN S. N. C^os GREAT SHIP.

PLATE Nº 2.



Smith C.E. direxit.

THE ARTIZAN JOURNAL, 1856.

W. J. Beever

THE ARTIZAN.

No. CLXII.—Vol. XIV.—JULY 1st, 1856.

THE EASTERN STEAM-SHIP COMPANY'S GREAT SHIP.

In continuation of our notice of the machinery of the great ship now in course of construction at Millwall, on the Isle of Dogs, we this month give the second plate of the series (Plate No. lxxx.), which exhibits a plan-view of that portion of the ship in which the engines and boilers, designed and constructed by Messrs. James Watt, and Co., for working the new propeller, are placed.

The Plate given in our last month's number exhibited accurately the sections of the vessel and its cellular construction, the general arrangement and dimensions of the parts between decks at the line at which the section is taken, and the disposition of the engines for working the screw-propeller; but otherwise, the details of the engines are not seen to advantage, the working parts being apparently crowded. The second Plate, however, exhibits the whole arrangement of the engines clearly and correctly in every particular, notwithstanding the necessarily small scale to which the parts are drawn, for the purpose of comprising the whole in one Plate.

We propose to reserve, until our next, the more detailed description of these engines, when we shall be enabled to fully describe and suitably illustrate some of their peculiarities, which are worthy of special notice; by which time we shall also, we hope, be in a position to give our readers a description of several important alterations which have been proposed in the construction and equipment of the ship, which it is expected will have, ere then, been decided upon; and at which time reference may be made to the Plate exhibiting the arrangement of the entire ship with its engines, boilers, machinery, and internal accommodations.

We have already referred to the boldness of the conception and the design of this great naval construction being due to Mr. Brunel; and on carefully examining the details, no disappointment is experienced at any point or part of the whole; every precaution that human foresight or ingenuity could provide has been adopted in carrying out the work, to insure the greatest stability, combined with the least weight and expenditure of materials. Thus, throughout the entire length of the ship, at present completed, the cellular construction of the sides, the bottom, and the main deck, converts the whole into one immense wrought-iron tubular bridge or beam. Moreover, the structure is further strengthened by ten water-tight iron bulkheads, 60 ft. apart; and again, by two continuous walls of iron, about 36 ft. apart, running longitudinally from the after (screw) engine-room to the cargo-space forward, a distance of about 350 ft., and forming a series of parallelograms 60 ft. × 36 ft.; in these divisions there is no weakening by the introduction of doorways, passages, or such like openings below the line of the second deck.

The dimensions of the engine-room, and one of the boiler spaces for the screw-engines, are shown in the Plates 1 and 2 of the present series (Plates lxxiv. and lxxx). The general arrangement of the whole of the engines, boilers, and machinery for propelling the ship will be described in the 3rd Plate, which will also show correctly the whole of the internal construction of the vessel, throughout its entire length, by means of three longitudinal views, with the details accurately drawn and the principal dimensions figured thereon.

The sides, as we have already stated, are composed of two thicknesses of iron plate, three quarters of an inch in thickness, and carried up to 8 ft. above deep-load-line, 3 ft. apart, being framed into cellular spaces by webs of plate-iron running longitudinally throughout the length of the vessel so constructed; these webs are secured to the plates by angle-irons, to which they are rivetted, as shown in Plate No. 1, which exhibits also the manner in which the plates are lapped. There are thirty-three longitudinal webs or ribs disposed throughout the bottom and sides of the ship in the manner shown, the distances between them so varying as to give the required amount of strength and resistance at the proper points. Each of these cellular spaces are rivetted and caulked water-tight, and, by means of sea-cocks and connections, water may be admitted into any required number of them in any part throughout the height on either side of the ship, by which means proper trim may be given to the ship, and a novel system of water-ballasting is thus introduced; or, if necessary, water may be admitted into the whole of the divisions on one side, so as to give her a sufficient "list" to enable repairs or re-painting to be done to her bottom. There being no keel and no ribs springing from it, as from a back-bone, the ordinary mode of ship-building has been ignored. It will be perceived that the hull is composed of two skins, with the ribs laid between them longitudinally instead of transversely; these, taken in conjunction with the subdivision of their length, the two main longitudinal walls of iron, the ten iron bulkheads, and the double main-deck, formed with cellular compartments similar to the bottom and sides, convey to the mind something like a correct idea of the vast strength and perfect unity of the whole structure.

In our next we purpose giving the most important of the practical details of that portion of the work which relates to the construction of the ship, illustrating them as far as possible with wood engravings.

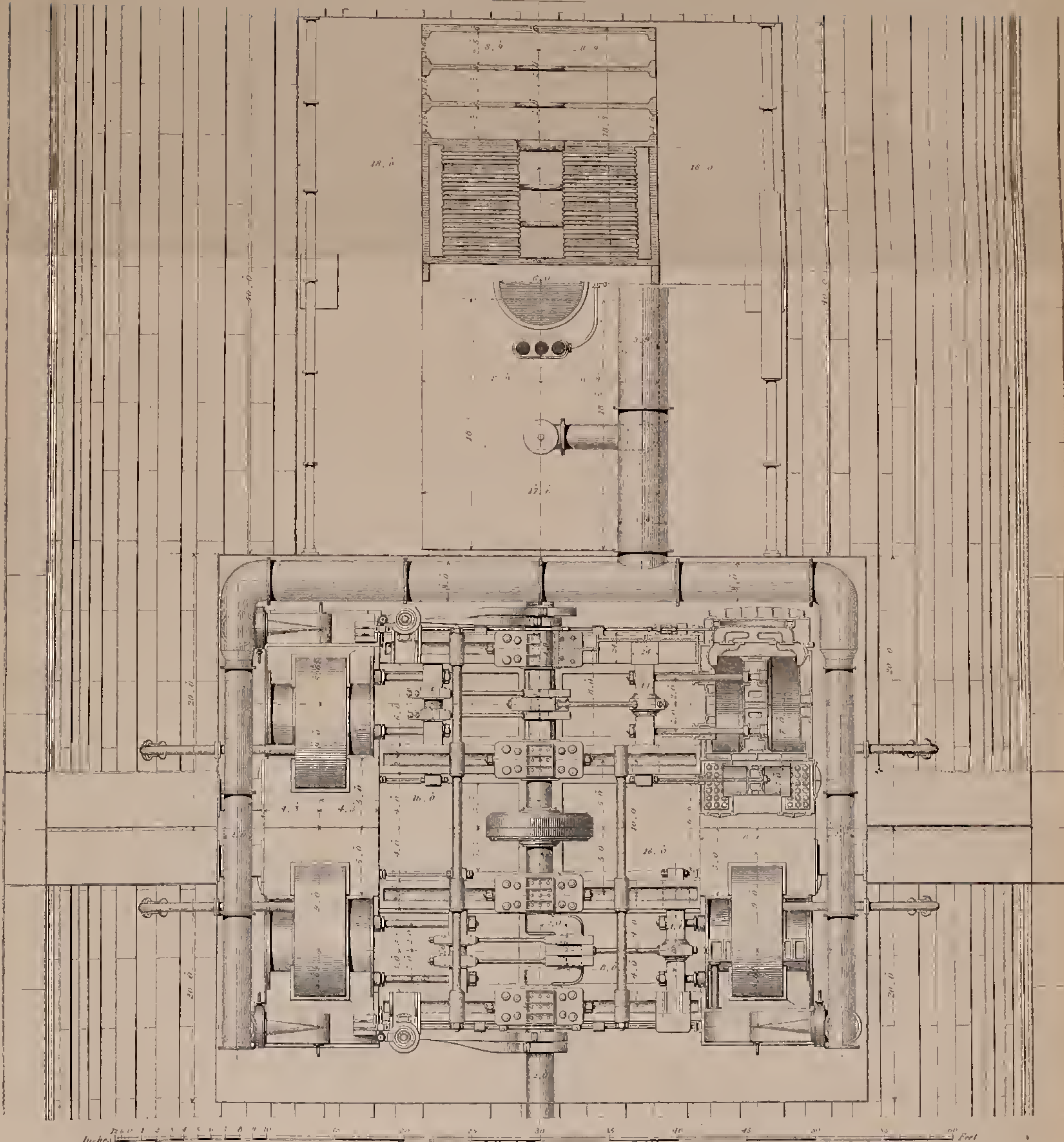
We then propose to describe and deal with the construction and arrangement of the ship in detail, following it with a description and plates of the paddle-engines, boilers, and machinery, designed and constructed by Messrs. J. S. Russell and Co.

Should we be unable to do so sooner, we shall be prepared by September to present our subscribers with a double Plate—being No. 3 of the series—containing three longitudinal views of the entire ship, and exhibiting the whole of the principal features thereof accurately drawn to a large scale, the chief dimensions being figured thereupon.

Of the many ingenious contrivances for labour-saving and other purposes connected with the economy of the ship, its proper working, and safe navigation, which have been designed for use on board, we will hereafter and in due time give accurate details: but which it is impossible at the present time to do. Moreover, of the equipment of the vessel, the number of masts and their disposition, nothing is yet definitely arranged. And thus until these essential points are finally determined, it would be a wasteful expenditure of our time and space to deal with them speculatively.

THE EASTERN S. N. C^os GREAT SHIP.

PLATE Nº 2.



W^m Smith C.E. Invent.

THE ARTIZAN JOURNAL, 1856.

W. J. Beever

DESCRIPTION OF THE DRAINAGE OF THE HAARLEM MERE.

(Continued from page 125.)

The width of the canal is not every where the same; from the *Schinkel-polder* on the south-east side of the lake to the sluices at *Halfweg* it has the greatest breadth, amounting to 45 met. (147½ ft.), for a good conveyance of the water to the sluices. From *Halfweg* to the *Oude Wetering* on the south side its breadth is 40 met. (131¼ ft.), the remaining part being 38 met. (124½ ft.) in width. At the foot of the enclosure bank, at the side of the canal, an enlargement has been made along its whole length, having a breadth of 6 met. (19½ ft.), for a towing-path, which, between the sluices at *Halfweg* and the *Spaarnè*, has been brought to 11 met. (36 ft.), a provision for the future enlargement of this part of the canal also, if necessary, to a width of 45 met. A second footpath, having a breadth of 2 metres (6 ft. 5 in.), has been constructed, for giving a greater capacity to the canal when (as in the winter) the waters rise to a high level, offering, at the same time, a ready means of increasing its capacity if hereafter found necessary. The top of the embankment has a height of 1·307 met. (4 ft. 3 in.) above the datum line, which we will notice hereafter. The breadth at bottom is generally 11 met. (36 ft.), at some points more, while its breadth at top, on the whole length, is 4 met. (13 ft.) Its slope on the side of the mere is five times the height; on the side of the canal, twice the height. A section of the canal and embankment is given (see Fig. 2), show-

Fig. 2.

ing its configuration where it intersects the low lands of the *Schinkel-polder*, thus necessitating a second embankment on the other side of the canal to isolate it therefrom. At the time of the construction of the embankment its height was considerably more than the intended one described above, this greater height being an allowance for the contracting of the materials of which its body was formed, a great deal of which was peat, a material, however, which, after being thoroughly dried, is very compact and impervious. At some points many and great difficulties had to be surmounted while constructing the embankment, arising from the softness of the soil, which was accomplished by the use of fascines and layers of sand, but which raised the cost of this part to 52·58 fl. per running met. (= £4 per yard), this being the highest price which was paid for the canal and embankment. Where they were not constructed through the water, the price varied from 21 to 32 fl. per met. (from £1 12s. to £2 8s. 8d. per yard). The construction of the embankment through the water was performed by the lowering of layers formed by fascines, until a good basis had been formed, on which was laid the body of the embankment. On the other side a second dam had to be constructed, after which the water was removed from the enclosed space, for the formation of the canal; the cost of these works being on an average 126 fl. per met. (£9 12s. per yard). Great difficulties arose at the construction of the canal and embankment on the south-east side, where the existing meres and pools had to be isolated from the lake. The small strip separating these waters, which seemed to be land was not really so, but consisted of water-plants, so tightly interwoven, that they formed a layer floating on the water, and of such a stability that a man could walk on it with perfect security. This phenomenon is met with at different places where a fenny bottom is covered by stagnant water, which greatly promotes the growth of aquatic plants, which originate at the bottom and afterwards float to the surface, where they collect and form the floating land as described. It was not an easy task to construct an embankment on such a foundation, but it was happily accomplished in the following manner:—At the place where the canal had to be made, the floating land was cut away, and the stuff thus got out was thrown up at the sides upon the line where the embankment had to be formed; thus, by continuously bringing upon it new layers, the floating land under the now partly-formed bank was sunk by the superincumbent weight, which was augmented by the materials resulting from the dredging of the bottom of the canal, until the first layer reached the bottom, at the depth of no less than about 3·5 met. (11½ ft.) beneath the surface. On this basis the body of the embankment was constructed, which has proved to be very compact and firm. The canal has a length of 59·596 kilom. (37 miles), and has cost, with the embankment, 1,938,328 fl. (£161,528), or 32·52 fl. per met. (£2 9s. 6d. per yard). The embankment, though at first not quite impermeable, which is seldom the case with such works when newly laid, showed no alarming symptoms of leakage, and has since stood very well. At some points new materials had to be brought upon it, to compensate for the lowering and contracting of the top, by the drying up of the materials of which it was formed, and many repairs had to be undertaken, in consequence of damages by storms before the finishing of the drainage. In 1843 the enclosure of the mere was finished, save the points which had to be held open for the navigation, and which were not to be closed before the commencement of the drainage, which was considerably delayed by many circumstances, the description of which, however, has little interest for the reader.

In the mean while it was taken into consideration what was the kind of engine and machinery for raising the water to be adapted, it having previously been determined that steam was preferable to the inconstant and variable force of the wind. The determining of this point was confided to the engineer, Byerinck, and the professors

Simons and Lipkens, of which the last-named is since deceased. The conclusions of their report were chiefly as stated hereafter.

The first point to be kept in view was that whatever description of engines were employed they were not only to be so constructed as to be suitable to empty the waters from the mere, but that afterwards they also might keep it dry. Once being dry, the same engines which had served to empty the lake, and therefore had been continuously at work, had but to be set in action at intervals for the discharging of the superfluous water resulting by rains and filtration, so that the force required for this purpose being known, the engines could be projected according to this basis, while they should be powerful enough to drain the lake by a continous action. The quantity of water to be carried off amounted to 724,000,000 cubic met. (about the same number of tons), to which were to be added 36,000,000 cubic met. yearly during the drainage, and 54,000,000 afterwards. But to ensure a good drainage afterwards, the most unfavourable circumstances had to be taken into consideration, that is, very wet months; the greatest quantity of water to be raised during one month amounted to 36,200,000 cubic met., which calculations were based on the results of observations continued during 91 years.

According to experiments the largest windmills used raise in no case more water than 60 cubic met. to the height of 1 met. per miuute. Experience has shown that such mills work with full force during no more than sixty days of twenty-four hours out of the 365 days of the year, so that such a mill can raise yearly about 5,184,000 cubic met. of water, or say 6,000,000 to the height of 1 met., or 19,374,000 tons of water to the height of a foot. It is assumed in practice that such a mill (the number being in due proportion to the surface of the land to be kept dry) must work thirty days yearly for thoroughly draining such low lands, so that the duty of such a mill may be reckoned at 3,000,000 eubic met. of water raised 1 met. yearly. These calculations are, perhaps, too much in favour of the windmills, it being the reporter's wish not to exaggerate the advantages of the use of steam power.

The height to which the water was to be raised after the drainage of the lake was 5 met. (16 ft. 5 in.), so that two rows of mills were required, the highest of which was to receive the water raised by the lower ones, and in each row were required 60 mills; or while there existed examples of land kept dry by a slightly less number, 57 mills were assumed for each row, or a total of 114.

A horse-power being equal to 75 kilos. raised 1 met. per second,* or 4·5 cubic met. water raised to the same height per minute, the useful effect of a horse-power actuating a pump may be fairly taken at 4 cubic met. raised 1 met. per minute, while if actuating scoop-wheels, or Archimedean screws, it will amount to 3·5 cubic met. Deducting a day monthly for stopping, the steam-engines, capable of discharging the quantity of water monthly under the most unfavonrable circumstances when moving pumps, should be of 1,084 H.P., while with the use of scoop-wheels or screws, 1,238 H.P. would be required, or, in round numbers, say 1,200.

It was, therefore, recommended to have single-acting engines, working pumps divided at three points of the lake; each engine of 360 H.P., or, when it should be found necessary to use less powerful engines, six engines of 180 H.P. each, which could be worked at 200 H.P.

If the use of wheels or screws should be preferred, two rows of engines were to be erected, each row having three engines of at least 200 H.P., so that a total of six engines would have to be constructed, of a collective power of 1,200 horses—these engines, however, to be double-acting.

Using windmills, the highest row, of fifty-seven mills, should be capable of emptying the half quantity in 14·2 months, or say fifteen months, after which time the lowest row could be erected. The second half having to be raised so much higher could not be discharged in less than at least double the time—say thirty-three months—so that, if all the circumstances were highly favourable, the mere could be drained within a space of four years. The price of each windmill was reckoned at 26,000 fl. (£2,166), and the expense for attendance and repairs 750 fl. (£62 10s.), so that the total expense for the 114 mills, during four years, including the interest on capital, would amount to rather more than 3,700,000 fl. (£30,000).

If single-acting steam-engines and pumps were to be used, taking but 250 working days annually, no less than 115 days being allowed for stopping, for repairs, and other causes, they could drain the mere in ten months and a half—say fourteen months—as a pump, in common with all water-raising machines, does not produce the same useful effect at the different heights to which the water is raised. It was calculated that the drainage in this manner would necessitate an outlay of 1,200,000 fl. (£100,000).

In the case of steam-engines actuatiug scoops or screws, the upper half of the water could be discharged by three engines, of a collective power of 600 horses in 6·1—say 8 months—when the other three engines had to be erected, and the remaining half—for the same cause as in the case of windmills—would require 12·7—say 16 months—so that the drainage in this case would be accomplished within two years, at an expense of 1,700,000 fl. (£142,000).

The yearly expenses for keeping the lands dry after the drainage would amouut, in the first case, to 74,200 fl. (£6,200), in the second to 54,000 fl. (£4,500), and in the third case to 73,000 fl. (£6,000).

The drainage by pumps, worked by single-acting steam-engines, offered an advantage in the expense of 2,500,000 fl. (£200,000), in favour of this system over that of drainage by windmills, while the difference of the yearly cost afterwards amounted to no less than 20,200 fl. (£1,600).

It having been decided that the lake should be drained by single-acting engines, having suction-pumps, according to the results of the calculations mentioned, the general arrangements and details of the engine and pumps remained to be determined—a matter of no common interest.

The sub-Committee of the Commission which had made the above report prepared a plan, and made different experiments, to devise the best construction of buckets and foot-valves for pumps of the great dimensions required. At the same time, the English engineers, Messrs. Gibbs and Dean, who, as early as the year 1839, had presented to the Government a plan of engines for draining the lake—which was then not approved of—offered a new plan of Cornish engines, applied to plunger-pumps, for the same purpose. In consequence thereof, it was resolved to charge the said engineers with the formation of a new plan, of which the principal points were prescribed by the sub-Committee, and accordingly the drawings were made. Eleven pumps were placed in the circumference of a circle, each pump being worked by a lever, and the opposite ends of these levers converging to the centre of the circle, where the steam cylinder was placed. On the top of the piston-rod a heavy weight was attached, which could be raised by the steam entering the cylinder from below, while the pump-buckets descended by their own weight. The piston having reached the top of the cylinder, the equilibrium valve had to be opened, allowing the weight to descend, carrying with it the eleven levers, which, at their other ends, raised the buckets. To take as much advantage as possible of the expansion, and diminishing, at the same time, the dead weight, it was proposed to adopt two cylinders, connecting their pistons, in the manner suggested by Mr. Simms, but instead of placing them one above the other, which would have required a considerable height, they were to be placed *one within* the other, so that the outer cylinder was to be furnished with an annular piston, moving simultaneously with the solid piston of the inner cylinder. Working with eleven pumps, at each stroke 66 cubic met. (nearly 66 tons) of water would be raised, which, for ten strokes per minute, would give 660 cubic met., or 950,400 cubic met. per day of twenty-four hours. The number of eleven pumps was adopted for the purpose of being able to work with a less number of pumps when the height to which the water had to be raised should increase, so that the

* This calculation of a horse-power, generally assumed in the decimal system, corresponds nearly with the one commonly used in England, it being reduced to English weights and measures, 32,549 lbs. raised 1 ft. per minute.

working pumps would always balance each other; and that, finally, only three pumps should be worked, making, one with the other, an angle of 120°, and which, with ten strokes per miuute, would raise 180 cubic met. per minute. After the drainage of the lake this quantity would have to be raised per minute to a height of about 5 met., corresponding with 900 cubic met. raised 1 met., corresponding with a power of 200 horses. If the double cylinder engine should realise the expectations, it would give out a power of 350 to 400 horses, so that, in such a case, six pumps would be moved—three on each side, balancing each other. It was, however, expected, and amply confirmed by the results, that more pumps, moved with a less velocity, would be preferable. This plan being adopted, the engine and pumps were contracted for by Messrs. Fox aud Co., and Harvey and Co., in Cornwall, while the eleven pump-levers and the boilers were contracted for by Messrs. Paul van Vlissingen and Dudok van Heel, at Amsterdam. In the mean while the building was commeuced on the south side of the mere, near the *Kager* Mere, on the spot marked ou the map *the Leeghwater*—this being the name to be given to the first engine to be erected for executing the great work, of which, two centuries ago, the idea was conceived and the plan made, by the enterprising man bearing the same name. Fig. 3 is a general plan (to a small scale), aud Fig. 4 is a sectional elevation of engine-house, engine,* and pumps; the building consists of a

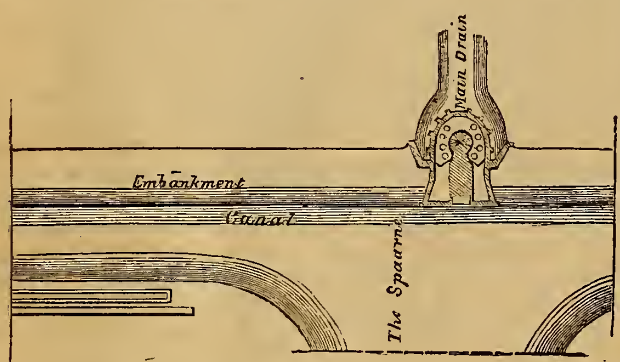


Fig. 4.—Plan.

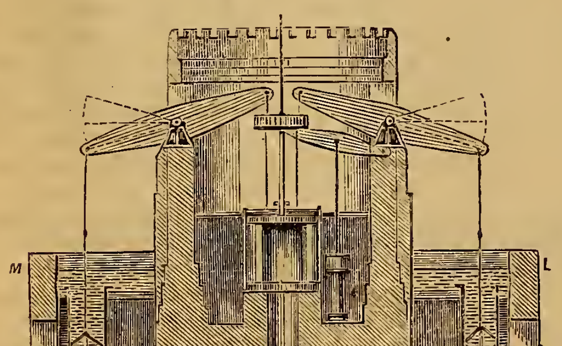


Fig. 3.—Sectional Elevation of Engine-house and Pumps.

round tower, in the centre of which the cylinder is placed, while it is surrounded, at some distance, by a strong wall, with arched apertures, to give access to the water. The foundation for this building was constructed by means of a heavy dam, and deepened out to about 7 met. (23 ft.) beneath the surface. No less than 1,000 piles, of a length of 12 met., had to be driven in the bottom, while the tower had to be supported upon 400 oak piles. On the top of these piles a strong wooden platform was laid, on which the brick walls were erected, those of the tower having a thickness of 3·08 met. (9 ft. 10 in.) at the footing, while the thickness of the surrounding wall is 1·54 met. (5 ft. 2 in). The inside diameter of the tower, at the level of the floor, is 9.25 met. (30 ft. 4 in.), while the space between the outer wall of the tower and the inside of the surrounding wall measures 5·80 met. (19 ft.)

The difference of the level of the canal, into which the water is discharged, amounts to 0·60 met. (nearly 2 ft.), the mean of which two levels we will take as the datum line for taking the measures of heights, and which we will call the mean level. (M.L.) In the space between the building and the surrounding wall, which rises to 1 met. (3 ft. 3 in.) above M.L., is laid a strong flooring of oak, at 1·33 met. (4 ft. 4 in.) below M.L. The pumps rest on bottom pieces, being open for the passage of the water; these bottom pieces, being set upon the wooden platform, which lies at a depth of 5·66 met. (18 ft. 7 in.) beneath M.L., while their heads pass through the flooring to a height of 0·78 met. (31 in.) below M.L., or 0·48 met. (19 in.) beneath the lowest level to which the water has to be raised. In the space between the building and the wall, above the floor, the water is received, and discharged on either side of the boiler-house by the sluice-gates corresponding with the canal, from which it is conveyed to the sea, at the different points, before indicated. The pumps of the *Leeghwater*, of which there are eleven, have a diameter of 1·60 met. (63 in.), while those of the two other engines, being eight in number for each engine, have a diameter of 1·85 met. (73 in.), the length of stroke of all the pumps being 3 met. (10 ft.) The buckets and foot-valves may be described as butterfly-valves, being so constructed as to offer the greatest possible area for the passage of the water, for which purpose the valve, on opening, rises with its hinges about 4 centim. (1½ in.), which, to a great extent, promotes, by the flow of water, the cleaning of the valves, from the mud which may collect there. The valves are constructed of plate-iron, 26 millim. (1 in.) in thickness, and rest upon beds of wood lined with leather. Experiments which were made with the aim of ascertaining the loss by leakage of the valves have shown that this loss amounted to no more than 1-10th of the whole quantity. The pump-buckets are moved by the great levers, having a length from centre to centre of 10 met. (32 ft. 10 in.), and weighing each 10,000 kilos. (10 tons), and are connected thereto by rods, to the lower end of which are attached chains, which connect them with the buckets. The chain is for the purpose of preventing a shock to the bucket-valves when the steam-piston should happen to rise with too great a velocity, and, by the flexible chains, the buckets will descend by their own weight, without being affected by the velocity of the piston. The other ends of the levers are connected to the great cap surmounting the piston-rods by suitable straps. This cap, having a diameter of 2·8 met. (9 ft. 2 in.), is divided into eight chambers, containing the dead weight, amounting, with the cap, to about 85,000 kilos. (85 tons). This cap is guided by the central piston-rod, which is lengthened above the cap, and moves through a stuffing-box in the beam by four guide-rods, two on each side of the cylinder. The engiue has, as is stated above, two cylinders, one within the other, the outer being provided with an annular piston, which has a diameter of 3·66 met. (12 ft. ¼ in.), while the inner cylinder has a diameter of 2·14 met. (84¼ in.), its thickness being 44 millim. (1¾ in.), so that their respective areas are as 1 : 2·9; their stroke is the same as that of the pumps—viz., 3 met. (10 ft.) The piston-rod of the central piston has a diameter of 30·5 centim. (12 in.), while the four piston-rods of the annular pistons have each 11·5 centim. (4½ iu.) diameter. These four piston-rods are connected at their tops to the great cap, which, accordingly, by its ascending and descending, determines the motion of the pump-buckets. The manner in which the steam works in the cylinders is as follows :— The steam is admitted on the up-stroke, and the piston, having reached the top, the equilibrium valve is opened, whereby the steam is allowed to enter at the top of the cyliuder, diffusing itself not only at the top of the inner, but, at the same time, of the outer cylinder, while the upper edge of the inner cylinder does not reach to the under side of its cover, but leaves a space of 1½ in. The steam pressure, above and below the piston of the inner cylinder, being thus in equilibrium, the piston descends by the expanding steam acting on the

* The sketch represents not *the Leeghwater*, but one of the two engines erected afterwards, with the different modifications which were considered necessary, of which the principal was the substituting eight pumps for the eleven, with an equal collective capacity.

annular piston, in this manner assisting the descent of the dead weight, which is reduced thereby in the same proportion. But the piston, which must remain stationary during some few seconds, to allow the valves of the pumps to close without a shock, should re-descend before the opening of the equilibrium valves, the expanded steam in the small cylinder not having force enough to hold up the weight. To meet this difficulty a particular contrivance has been applied, which, in its general arrangement, may be described as a cataract. It consists of two plunger pumps, having a diameter of 23 centim. (9 in.), attached to the extremities of the cap. When the piston ascends, these pumps are filled with water from pipes, having a height of 10 met. (32 ft. 10 in.), with which they communicate by valve-chests containing only suction-valves. At the top of these chests are pipes, which unite in a single valve-chest containing a valve, which can be lifted by a falling weight actuated by a cataract, which, at the same time, raises the equilibrium valve. When the piston has reached the top of the cylinder it remains stationary, on account of the plungers not being able to return until, by the action of the cataract, the valve is lifted and the water returns to the pipes. At the same time, the equilibrium valve is opened, allowing the steam to act upon the top of the pistons. During the short period of rest, the pump-buckets reach the bottoms of their respective pumps, while the valves are closed gradually. At first sight it may seem that the pumps to uphold the weight are superfluous, and that it would have been possible to omit them, by not expanding the steam in the inner cylinder, and proportioning the capacities of both cylinders in such a manner that the final expansion should take place in the outer cylinder. But it must be remembered that in such a case the difference between the initial and final pressure at the descending stroke would have been far too great, so that the piston would have descended with a velocity which would have been dangerous for the whole engine, and especially for the pumps, even so that with the actual arrangement a throttle-valve is placed in the equilibrium pipe to moderate the descent. The pressure at the commencement of the descending stroke is about 19 lbs. per sq. in. (the habitual working pressure being three atmospheres), and the pressure at the end of the stroke is 8 lbs. per sq. in., giving a difference of 11 lbs.; while, with another proportion between the capacities of the cylinders, the end pressure remaining the same, the initial pressure would have been 30 lbs., giving a difference of 22 lbs., or double that of the actual pressure.

The engine has two air-pumps, one of which is indicated in the sketch, each being actuated by a lever which is connected to the cap; they have a diameter of 1·02 met. (40 in.), and 1·52 met. (5 ft.) stroke. The *Leeghwater* has five boilers, but the two latter engines erected have each six of the same dimensions; the sixth boiler being added, not from any want of steam, but so as to have a greater boiler-room, whereby the advantage of a slow combustion could be obtained. The boilers are contained in the boiler-house, indicated in the plan, Fig. 4, and are cylindrical, with internal flues. They have a diameter of 1·82 met. (6 ft.), the diameter of the flues being 1·22 met. (4 ft.), and their length 9·15 met. (30 ft.) A cylindrical steam chamber, having a length of 12·80 met. (42 ft.) and a diameter of 1·37 met. (4 ft. 6 in.), is placed transversely over the boilers, communicating with each of them by a particular stop-valve. The steam pipe to the cylinder has a diameter of 0·61 met. (2 ft.) The contract price for the building was 161,000 fl. (£13,800), while the engine and boilers have required an expense of 207,050 fl. (£17,254). Experiments conducted by the sub-Committee to test the power and economy of the engine show that the engine is capable of giving out a net power of 500 horses, and even more. At the most favourable experiment the consumption of fuel was 1·17 kilos. (2·6 lbs.) per H.P. per hour, and the duty 70,000,000 lbs. raised one foot high by the consumption of 94 lbs. of coal. In many of the engines in Cornwall the highest duty is considerably more, even as high as 100,000,000 lbs.; but it must not be overlooked that the motion imparted to the water requires a certain force, which remains constant at all heights. Accordingly this force, while it bears but a very small proportion to the total power to be expended when the water has to be raised to a very great height, as is the case in mines, bears a far greater proportion to the force required when the water has to be raised to no more than 5 met. (16½ ft.), and may considerably affect the economy of the engine. It is most difficult to estimate the value of this force, no experiments having been made which can be fully relied upon. For testing the power of the engine an experiment was made with the eleven pumps, raising the water to a height of 5 met. (16½ ft.), that being the maximum height to which the water was to be lifted after the drainage. The number of strokes at that time being eight, the net power—deducting 1-10th for the loss by leakage —was 528 H.P. This number of strokes with such a load, and even with a less height, was considered unsafe, and was not required, so that generally the number of strokes has been from five to seven.

In the month of November, 1845, the *Leeghwater* was ready, and the drainage might have been commenced if no great difficulties had arisen between the direction of the district *Rhynland* and the Commission about the height to which the canal (being part of the *boezem* of the said district) would have to be raised by the action of the engines. This question was not settled until the latter part of the year 1847, at the commencement of the winter, when the *boezem* was at a high level, so that had pumping been commenced at that time the water pumped out during the winter would have been discharged, naturally, in the spring, when the *boezem* stands always on a lower level.

(*To be continued.*)

THE RIVER DANUBE.

In our last Number we gave a short paper, by Mr. G. B. Rennie, containing some suggestions for the improvement of the River Danube, and a description of the past and present state of the Sulina entrance. In our present Number we give two plates (Nos. lxxvii. and lxxviii.), illustrating the plan proposed for improving the river.

The first is a general plan of the river from Isaktcha to the sea, where it is seen that the river divides into three main branches—the St. George's, the Sulina, and the Kelia—forming a delta. This delta consists principally of soft marshy ground. On this plan are shown several short canals, amounting to 18 miles in length.

The second plan shows more particularly the Sulina mouth, with the soundings, taken from a survey made by the officers of Her Majesty's ships during the last war. Two piers are also shown stretching out in a north-easterly direction from the mouth of the branch to beyond the existing bar.

We will here recapitulate in a few words what was said in our last respecting the proposed improvements; namely, it is proposed to unite the present branches or channels into one—the Sulina branch; to straighten that channel by means of short canals, to facilitate the exit of the water, and thus deepen the channel; and to construct piers or jetties at the entrance, to give greater facility for the arrival and departure of vessels; and deepen and clear away the present bar.

The trade of the Danube principally consists in grain, the amount of which, in 1851, before the last war commenced, was more than one million and a half of quarters—the tonnage for conveying it rather more than 300,000 tons—besides other articles, such as tallow; but should the export of grain be facilitated by easy and good navigation, the amount would be very much larger than heretofore.

It has been proposed by some other parties to construct a canal, harbour, &c., from Kostendjeh, on the Black Sea, to Czerinvoda, on the banks of the Danube. We estimate the total cost of this work, including harbour and docks, reservoir, &c., to be not less than £1,000,000, taking the canal, of about thirty miles in length, at an average of say £20,000 per mile; the time of completion, from its commencement, not less than five years. The plan, when constructed, would, no doubt be good for a certain part of the Danube trade, but the grain from Ibraila and Galatz would have to be taken against the current, which seems to us a considerable disadvantage; and nearly the whole of the works would have to be constructed before any return of interest on capital could be obtained.

The plan now before us offers the advantage of no impediment being thrown in the way of the navigation during the progress of the work; but as the works proceed a corresponding improvement of the depth of water, and the facility of the arrival and departure of vessels, will be the result. The estimated cost of these works would be—say the canals, eighteen miles in length, at £20,000, the piers at £80,000 per mile—say a total of rather more than half a million. Moreover, the trade would not be diverted from its present channel, to the great inconvenience of the present ship and warehouse owners, and sacrifice of vested interests.

The above suggestions only refer to the improvement of the River Danube below Isaktcha; but the impediments which exist in the upper part of that great river, viz., between Linz and Galatz, and which has been hitherto almost exclusively navigated by the Imperial and Royal Danube Steam Navigation Company, are such, as at periods of low water, to interrupt entirely the communication by steam between the upper and lower parts. These impediments exist—

1st. Between Linz and Göniyö, where the river runs through an alluvial soil, causing it to disperse over a wide surface, and creating changing banks and irregular channels.

2nd. Between Göniyö and Moldava, a distance of 114 German miles, the navigation is good, except during the winter, when obstructed by ice.

3rd. From Moldava to Thurnin Severin there are many rocks and shallows, especially the Iron Gate and other cataracts, which are only navigable during flood or high water, but which, in mean or low water, are almost wholly impassable; the consequence is that goods must be trans-shipped into waggons and barges, and so transported from the Lower to the Upper Danube, and *vice versa*, at such a cost as to stop the trade entirely in agricultural produce; in fact, instances have occurred when the Steam Navigation Company barges have had to wait below the Iron Gate, amounting to from forty to eighty vessels, each laden with 250 tons of corn, from the want of water to carry them over the rocks, the corn rotting all the time in the barges, whilst prices at Pest were very high, and in Germany almost at a famine price.

These inconveniences happen more or less annually, according to the state of the river; and the crops which, in Wallachia, are in general superabundant, although not half the land is cultivated, that which is cultivated is done in a most slovenly manner, for want of the advantages of a good, cheap, and regular system of conveyance. Thus, were these defective parts of the navigation of the River Danube remedied, and they are quite within the scope of modern engineers, the advantages to this and other corn-consuming countries would be invaluable. The extent of the country comprised by the basin of the Danube and its affluents, such as the Drave, the Save, the Theiss, and the Bega, the whole of Moldavia, Wallachia, and the extensive countries watered by the Danube, would thus be opened out to steam, and the supplies of corn, cattle, wool, and other products, would be almost beyond the limits of calculation. Even under the present defective system, in 1852 the export of grain was upwards of two millions of quarters.

We have, therefore, much pleasure in laying before our readers the plans suggested by Mr. G. B. Rennie. They are thoroughly practicable, can be executed at a comparatively small cost in very short time, and with immediate prospects of beneficial results, the present navigation will not be interfered with during the progress of the works; and we hope to be able, very shortly, to state that the works are in progress.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(FROM OUR OWN CORRESPONDENT.)

Southampton, June 23rd, 1856.

Our dry docks have been lately in great demand, chiefly by steam-transports, the owners of which are naturally anxious to make the most they can by their vessels, and more particularly as their services will soon be dispensed with by the various Governments now employing them.

The screw steam-ship *Clyde* arrived here on the 4th inst. for docking and repairs, and sailed on the 16th inst. for Gibraltar with artillery; she will thence proceed to the Crimea for troops homeward bound. This is the same vessel in which two lives were lost about two years since from the collapse of the chimney uptake, caused by the setting fast of the stop-valve of the starboard after-boiler. The readers of The Artizan will remember that the safety-valves were placed on a box or chest, separated from the four boilers, the communication between them being through the stop-valves; and one of these having set fast, the steam in that boiler had no means of escaping, and consequently produced the accident referred to. This arrangement was of course immediately altered, after the inquest at Portsmouth, and the Board of Trade shortly after made it imperative on owners of passenger-vessels that the safety-valves of boilers should be entirely independent of stop-valves, or, to use their own words,—"That no boiler or steam chamber is to be constructed, fitted, or arranged, as that the escape of steam from it through the safety-valve, required by Act of Parliament, can be wholly or partially intercepted by the action of any other valve." The safety-valve mentioned refers to one communicating with each boiler, which cannot be meddled with by the engineer without the consent of the captain, as it is locked up and the key kept by the captain. Should the engineer in any way contrive to get at this valve, in an illicit manner, he would become liable to prosecution.

The engines of the *Clyde* are made by Messrs. Scott and Sinclair on their patent inverted and inclined principle; they are geared engines, the multiple being $2\frac{1}{2}$.

Diameter of cylinders	52 in.
Stroke of piston	4 ft.
Revolutions per minute, full speed	28
Do. do. average at sea	25
Nominal H.P.	200
Do. at 25 revolutions	180

Three-bladed screw 14 ft. diameter × 15 ft. pitch.

Speed of screw at 25 revolutions per min. = 9·3 knots per hour.

Do. of vessel in smooth water . . = 9 do.

Slip of screw do. about 4 per cent.

The consumption, with good Welsh coal, is about 30 tons per day; this equals $15\frac{1}{2}$ lbs. per nominal H.P. (of 180) per hour, and is very heavy; particularly so as the pressure of steam in boilers is only 8 lbs.

The *Clyde* is a fine vessel, by Messrs. Denny, schooner-rigged, three masts.

The Franco-American Company's screw-steamer *l'Alma* was towed here from Havre to be docked, as her propeller was fouled and stuck fast. It appears that the corner of one of her screw-blades, having been knocked off by striking something, was repaired in Havre by rivetting a piece of boiler-plate into it, which, projecting beyond the true diameter of screw, came in contact with the vessel's keel when the engines were moved, and there jammed hard and fast. Of course the remedy of cutting away the prominent part was soon applied, the vessel only being in dry dock one day.

L'Alma is a very fine vessel, by Mr. John Laird, of Birkenhead, and, like all vessels constructed by that eminent iron ship-builder, is well and faithfully put together. When in dry dock we carefully examined her bottom, and could not discover a single loose rivet or leak in any part of her.

Her dimensions are:—

	Ft.	In.
Length between perpendiculars	270	0
Beam	36	5
Depth	23	0
Tonnage, O.M.	1,750	

Displacement at 17 ft. 4 in. load-line = 2,565 tons.

Area of immersed midship section .... 509 sq. ft.

Direct-action inverted cylinder engines, by Messrs. Humphreys, Tennant and Dykes, of Deptford.

Diameter of cylinders	64 in.
Stroke of piston	32 in.
Revolutions at sea, average, per minute	55

These engines differ from the ordinary inverted cylinder engines of other makers by having two air-pumps placed beneath each cylinder, the air-pump rods passing direct from cylinder piston through stuffing-boxes to the air-pump buckets, a sufficient space being left between bottom of cylinder and covers of air pumps for drawing and packing the buckets.

The guide for piston-rod is bolted to one air-pump, and is made thus :—

The large surface receiving the thrust of connecting-rod when engines are going ahead, and the smaller surfaces when going astern.

These are, perhaps, the most compact direct-action engines which can be made. The working parts are reduced almost to a minimum. The objection to them at first sight would be that they are much more unbalanced than the ordinary inverted engines, in which the air pump worked by a beam is used to balance the piston and connecting rod. Messrs. Humphreys, in these engines have, however, to some extent got over this difficulty, by a balance-wheel keyed on to the end of crank-shaft, and forming the coupling of crank-shaft to screw-shaft, the circumference having teeth or notches on it for turning engines by hand.

This wheel is loaded on sides opposite to cranks, with weights sufficient to put the engines nearly in balance.

L'Alma has a 2-bladed screw 16 ft. 6 in. diameter × 22 ft. pitch, and as the engines average 55 revolutions per minute at sea, the speed of screw = 12 knots per hour. In fine weather she averages 10 knots per hour under steam alone, which gives a slip of the screw about 16 per per cent.

The indicated H.P. of engines on trial equalled 1,263 H.P. with 57 to 58 revolutions. Steam, 18 lbs. ; vacuum, 27 in.; 4 tubular boilers; 16 furnaces, each 2 ft. 11 in. wide × 5 ft. 9 in. long = 268 sq. ft. grate surface, and about 7,000 sq. ft. of heating surface.

L'Alma sailed hence for New York on the 14th inst.

Her Majesty's ship ***Himalaya*** arrived at Spithead, from Halifax (Nova Scotia), on the 17th inst., making a most extraordinary run. She left Halifax on the 8th inst., at 9·20 a.m., and on the 16th, at 5·30 p.m., signalled her arrival at Plymouth = 8 days, 8 hours, 10 minutes, from which deduct 4 hours 10 minutes for difference of time, which equals 8 days 4 hours ; and as the distance is 2,510 knots, her mean speed was 12·8 knots per hour. The average revolutions of engines were 50 to 52 per minute, say 51. Pitch of screw, 28 ft. Her speed of screw = 14 knots per hour, giving a slip of 9 per cent. Average consumption of coal about 78 tons per day. She experienced fine weather on the voyage, with light, fair winds. The square sails, however, were only set for about 36 hours on the voyage. When we compare this passage with that of the ***Persia***, viz., 9 days 8 hours from New York to Liverpool, a distance of 3,020 miles, giving a mean speed of 13·4 knots per hour, we must remember that the ***Persia*** is of very little more tonnage than the ***Himalaya***, but has engines of at least 1,000 nominal H.P., and consumed on that remarkable passage from 120 to 140 tons of coal per day.

The ***Himalaya*** is about to proceed again to the Crimea for homeward-bound troops.

The ***Hammonia*** screw-steamer, is well worthy of notice in our columns, and whilst in dry dock here we had a good opportunity of inspecting her.

She was built and engined by Messrs. Caird in 1854 and 1855, for the Hamburgh and New York Company, and has been constantly engaged during the last twelve or thirteen months by the French government as a transport, having earned, we understand, about £51,000.

Length between perpendiculars	280 ft.
Length of beam	38 ft. 6 in.
Depth of hold to spar-deck	26 ft.
Depth of poop-deck aft	7 ft.
Twixt decks	7 ft. 6 in.
Tonnage O.M.	2,026
Keel	10 ft. × 3 ft. ; tapering to 7 ft. × 2½ ft.
Outer stern post	9 ft. × 4½ ft.
Inner stern post	9 ft. × 6 ft.

Frames spaced 18 in., and 5 ft. × 3 ft. × ⅝ ft. ;
floors, 24 in. deep × ½ in. thick.
Garboard strake, ⅞ ; midships to ¾ at ends.
Bilge strakes, $\frac{11}{16}$; midships to $\frac{9}{16}$ at ends.
Wale strakes, $\frac{11}{16}$; midships to $\frac{7}{16}$ at ends.

She is a very handsome vessel, barque-rigged, elliptical stern. Can carry 500 passengers, and 1,000 tons cargo.

Oscillating geared engines, of 375 H.P. ; multiple, 3 to 1.
Cylinders, 67 in. diameter × 6 ft. stroke.
Revolutions, on trial, with 15 lbs. steam, 24 ; revolutions at sea, 21 to 22.
3-blade screw, 13 ft. diameter × 18 ft. pitch.

THE CRYSTAL PALACE WATERWORKS.

On Wednesday, the 18th June, the final portion of the great system of fountains, cascades, &c., was worked, the whole being put into play with perfect success in the presence of Her Majesty, the Royal Family, and some 20,000 visitors.

The vastness of the arrangement of jets and pipes—of basins, reservoirs, water-towers, and other works of construction—of the steam-power and machinery for raising the water to supply this enormous system of hydraulic works for display—demands an amount of space which we are unable, this month, to devote thereto; but we have in course of preparation a series of plates of some of the principal works, and also a series of illustrations on wood, by which we hope to do ample justice alike to the work, its designer, his assistants, and the contractors who have been employed.

In the mean time we offer to our readers a short, popular, and general description of the works, supplied to us by Mr. Shields, the Company's resident engineer, but which will, nevertheless, convey important and serviceable information relative to the chief points ; and we reserve, until next month, the amplified and accurate practical details, which, we doubt not, will be most acceptable to our readers.

"The arrangements for a system of waterworks of such magnitude and variety as those at the Crystal Palace are necessarily somewhat difficult of description. It is hoped, however, that a correct general idea of the plan on which they are constructed and worked may be conveyed by the following account :—

"The supply of water for ordinary purposes, and for provision against fire, within the Crystal Palace and through the grounds, are comprised in these waterworks. But their principal object is the formation of the Great System of Fountains, of which the arrangement will now be described.

"Within the Crystal Palace itself are various ornamental fountains, though necessarily of lesser magnitude. The principal of these are the bronze fountains in the basin at the junction of the nave and north transept, and the crystal fountain, which formed so prominent a feature in the Exhibition of 1851. The others are distributed through the architectural courts.

"In the ornamental basins on the terrace, and below it, there are two distinct series of fountains. The upper series comprises the nine basins adjacent to the main building, and terminating with the large circular basin on the central walk through the gardens.

"The second series comprises all the fountains. It includes the first series, and in addition to them the more extensive fountains in the temples, cascades, and two large basins in the lower grounds, which terminate the water display.

"The upper series, or ordinary display now daily exhibited, can be worked independently of the others. But when the lower fountains are shown, the whole display is brought into action.

"The next portion of the system to be described is the arrangement in connexion with the fountains of the tanks and upper reservoir, containing the supply of water for the jets, and of the lower reservoirs, where it is collected after being displayed.

" The water for supplying the fountains is maintained at three different elevations. First, in the two high tower tanks, which supply the 250 ft. jets in the centres of the lower great basins. Secondly, in two lower tanks, which contain water for fountains and for ordinary use in the building, and are situated near its northern extremity. These tanks supply also the high central jets in the upper series, as well as four secondary jets round each 250 ft. jet in the lower grand basins.

" The supply at the third elevation is contained in the large upper reservoir at the northern end of the building. This reservoir contains about 6,500,000 gallons, and from it the great body of the water displayed in the fountains is drawn.

" Two 30 H.P. pumping engines are placed at the upper reservoir for raising water from it into the high and low tanks above described.

" The reservoirs for collecting the water after its display in the fountains have now to be described.

" There are two of these reservoirs—namely, one for the upper and one for the second series of fountains. That for the upper series (usually called the intermediate reservoir) is situated at some distance to the north of the central circular basin, and a little below it in elevation. It collects the waste water from the ordinary display of the upper fountains, which is first received into the circular basin, and flows from thence into this reservoir.

" Four 40 H.P. engines are placed adjoining the intermediate reservoir, which raise or return the waste water from it to the upper reservoir, so as to render it again available for display.

" The receiving reservoir for the second series of fountains (which is called the lower reservoir) is situated below the south grand basin. It is of still larger capacity than the upper reservoir, as it would be required to receive all the water contained in the latter and in the high and low tanks, in the event of its being all displayed. The lower reservoir is constructed in the form of an ornamental lake, and representations of various strata and extinct animals, illustrative of the science of geology, are placed on its eastern banks. The lower reservoir collects the waste water from the entire system of fountains when in full operation; the waste being first received into the grand basins, and flowing from thence into this reservoir.

" Two 40 H.P. engines are provided to raise or return this waste water from the lower to the upper reservoir, so as to be again available for display.

" An Artesian well is also sunk in the lower part of the grounds for a water supply, and a small engine provided for raising the water from it to the lower reservoir. The well consists of a brick shaft of 8½ ft. diameter, and 247 ft. depth, from whence a boring is sunk to the additional depth of 328 ft., being a total depth 575 ft. The strata consists of clay and sand for 360 ft. from the surface, and of chalk for the remainder.

" Some further details may be added in conclusion respecting the fountains themselves.

" The water displayed in the upper terrace fountains is conveyed through pipes to the large circular basin, where it plays a second time in the low network jets round the margin, and in the other low jets through the basin. Again, when the lower great fountains are displayed, all the waste water from the circular basin is similarly conveyed to them to play their jets of low elevation. Thus the water from the terrace fountains is displayed thrice, and that from the circular basin twice, throughout the entire operation.

" The magnitude of these fountains may be conceived from the circumstance that when the great waters are in full operation, there are 11,788 jets playing, and the quantity of water displayed simultaneously in them is about 120,000 gallons per minute.

" These works were designed by Sir Joseph Paxton. Six contractors were employed under him in their execution :—viz., Messrs. Cochrane and Co., Simpson and Co., Easton and Amos, Aird, Cox and Wilson, and Roe. The engineering operations were executed under the superintendence of Mr. Shields, the Company's Resident Engineer."

ON WOOD BEARINGS FOR SCREW PROPELLER SHAFTS.

Paper read before the Institution of Mechanical Engineers, January 30, 1856,

By Mr. John Penn, of London.

W. Fairbairn, Esq., F.R.S., in the Chair.

In the bearings of the shafts of screw-propellers a considerable difficulty has been experienced when the screw has not been kept in regular work, but has been required to stand still for several hours, or even days together, as is more particularly the case with war-steamers. In such cases it has been found requisite, in timber vessels having copper sheathing, to protect the wrought-iron screw-shaft by a brass casing, wherever exposed to the action of the sea water; since otherwise, the galvanic action excited by the copper causes a serious and rapid corrosion of the iron shaft, and its bearings soon become injured. A similar action takes place also in iron vessels, but not to the same extent. The shaft is consequently cased throughout with a brass tube, A, as shown in the longitudinal section, Fig. 1, Plate, and the transverse section, Fig. 2; the tube, A, fits close to the shaft, B, at the journals, and is loose from it between them. But the friction and wear at the bearings is in this construction very great, as the brass casing of the journals has to turn in brass bushes; and the result is a very rapid wear, and a great difficulty in keeping the bearings long at work. Moreover, the screw-propeller itself is a heavy mass, weighing in some cases from 10 to 12 tons, coupled at the end of the shaft by a **T** cross head, C (Fig. 1), for the

WOOD BEARINGS.

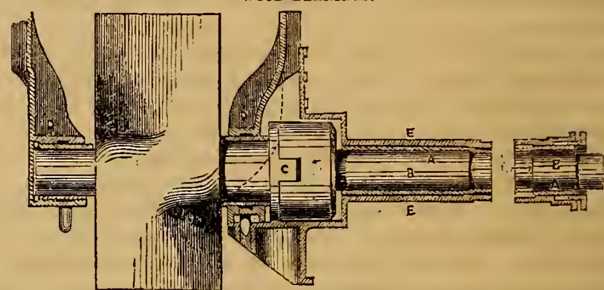


Fig. 1.—Longitudinal Section.

purpose of easily unshipping and raising it out of the water by means of the lifting bearings, D D, when it is not required for steaming. The wear of the brass bush is very uncertain and various, and has been found to amount to as much as an inch in thickness in the course of a few months.

The author of this Paper, having had his attention forcibly called to the subject by these circumstances, made a series of experiments on different materials as bearing surfaces, and the final result has been the adoption of wood bearings for the screw-shafts, and these have now come into general use for this particular application with complete success.

The method in which the wood is employed is shown in Figs. 2 and 3;

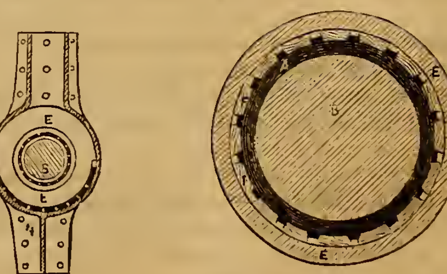


Fig. 2.
Transverse Section.

Fig. 3.
Transverse Section of Shaft and Bearing.

the ordinary brass bush, E, has longitudinal dove-tailed grooves formed on its face, which are filled with strips of hard wood, F F; lignum vitæ has been generally used. The strips of wood are about 2½ in. wide, with a space of about three-quarters of an inch between each, and stand out a quarter of an inch from the surface of the brass; water is kept constantly flowing between the strips along the shaft, and forms the only mode of lubrication, and this is found to prevent all tendency to heating or wearing of the journals.

Besides a large number of merchant vessels, upwards of 200 of the last new ships constructed for Her Majesty's service have been fitted with wood bearings, and all former vessels are being altered to the same plan as fast as opportunities will permit. As far as present experience has gone, neither the wood nor the journals appear to suffer any appreciable amount of wear or deterioration after many months' continued exposure to the action of the water.

The *Himalaya*, of 3,500 tons and 700 H.P., furnishes perhaps the best practical proof that can be adduced of the durability of the wood bearings. This ship was fitted in the first instance with the usual metallic bearings, but the wear was of so serious a nature as to induce the proprietors of the vessel to adopt the improved plan almost immediately after the author's discovery of its utility. The *Himalaya* being shortly afterwards purchased by the Government was employed as a transport, and during the first ten months of her service she steamed 20,000 miles without exhibiting the slightest signs of wear in those parts which had previously given so much trouble. The screw of the *Himalaya* weighs upwards of 11 tons, and is not fitted with the means of raising it out of the water; and consequently, having no after bearing, the whole weight, in addition to the projecting portion of the shaft, is carried by the stern-bush alone.

Her Majesty's sloop *Malacca*, of 200 H.P., also furnishes good evidence of the advantages of wood over brass and other metallic bearings. This vessel gave similar trouble to the *Himalaya* as long as it was fitted with brass bearings; but when last examined, since the application of the wood bearings, it had run over a still greater distance than any that it had accomplished previous to the use of them, without exhibiting the least signs of decay or want of adjustment in any of the bearings. The bearings had been fitted with lignum vitæ as a leading experiment for ships in the service of the Crown.

The ordinary brass bearings of screw-shafts are made very long in proportion to their diameter, so that the pressure on them is only about 60 lbs. per sq. in. when the journals are in contact throughout; but this pressure is considerably increased in practice, owing to the bearings being sometimes thrown out of line by the straining of the vessel.

In the wood bearings, the surface is reduced more than 1-4th by the space left between the strips of wood; but it appears from the results of working that 1-10th of the area of bearing surface is sufficient with wood as compared with brass. The wood bearings are found to stand a working pressure as great as 2,000 lbs. per sq. in.; and in some experiments made to ascertain the point at which abrasion would commence, a pressure of 8,000 lbs. per sq. in. was sustained without producing abrasion; whereas brass on an iron bearing at a pressure of 200 lbs. per sq. in. was found to cut directly, whether lubricated with oil or water, and failed quickly by the rapid cutting or abrasion.

The experiments which led the author to the adoption of the wood

APPARATUS USED FOR EXPERIMENTS.

Fig. 4. Transverse Section.

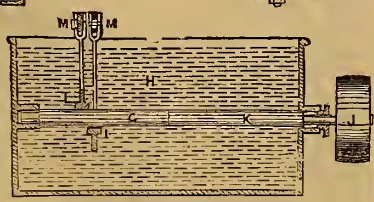


Fig. 5.—Longitudinal Section.

bearings were made with the apparatus shown in Figs. 4 and 5, consisting of a wrought iron axle, G, $1\frac{1}{2}$ in. diameter, running in wooden bearings at each end of a trough of water, H, 2 ft. long. The axle was immersed wholly in the water, and driven by a pulley, J, on the outer end, at a speed of 700 revolutions per minute, representing a velocity of 260 ft. per minute at the circumference of the axle, which corresponds with or rather exceeds the ordinary velocity of the journals of screw-shafts. One-half of the length of the axle, K, was covered with brass, the object of which was to try alternately the effect on brass and iron under precisely the same circumstances. A cylindrical bearing $1\frac{1}{2}$ in. diameter and 2 in. long was turned on the centre of each portion of the axle, upon which were placed the experimental bearings of which the relative frictions were to be ascertained; and in order to prevent any source of error from friction in the fixed bearings at the extremities of the axle, two experimental bearings, L L, were used at the same time, placed close together side by side, one above and the other below the axle, and pressed against the journal in opposite directions by two weighted levers, M M, having adjustable weights to regulate the pressure. By this arrangement, the axle was, as it were, suspended freely in the trough of water, having no material friction in the fixed bearings at the extremities.

The relative friction of the different materials under trial was measured by the rise of the temperature of the water in the trough in a given time, caused by the rotation of the axle, the quantity of water being exactly 2 cubic ft. in each case, and at the same initial temperature. In estimating the pressure to which the bearings were subjected, 1 sq. in. of bearing surface was used, and the total weight on each bearing gave the pressure in lbs. per sq. in.

The particulars of the experiments are given in the Table appended, and the general results obtained were as follow:—

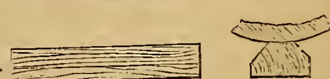
Description of Bearing.	Pressure per sq. in.	Time of Running.	Result of Experiment.
	lbs.		
Brass on Iron...........	448	30 mins.	Little or no cutting.
Brass on Iron...........	675	1 hour.	Cut and abraded.
Brass on Iron...........	4,480	—	Seized and stuck fast immediately.
Lignum Vitæ on Iron....	1,250	36 hours.	No signs of wear; original slight scratch not worn out.
Box on Brass............	4,480	5 mins.	Not cut.
Lignum Vitæ on Brass ..	4,000	5 mins.	No injury. This specimen is shown full size in Fig. 6.
Snake-wood on Brass	4,000	5 mins.	No injury. Shown full size in Fig. 6.
Cam-wood on Brass......	8,000	5 mins.	No injury. Shown full size in Fig. 7.

In the foregoing experiments, the principal object was the prevention of the serious evils attending the ordinary bearings of screw-shafts; and the circumstances under which the experiments were conducted were

PIECES OF WOOD EXPERIMENTED UPON.

Fig. 6.—Full Size.

Fig. 7.—Full Size.



therefore arranged to correspond as nearly as possible with those experienced in the actual working of ordinary screw-shafts; the experimental axle was wholly immersed in salt water, and was driven in all cases at a speed equivalent to that of screw-shafts on the largest scale.

The result obtained from these experiments was so definite and satisfactory that arrangements were immediately made for the application of the wood bearings to the screw-shafts of Her Majesty's ships, and these have in every instance succeeded beyond expectation. The author proposes, however, to resume the experiments on the first opportunity, in reference to the application of the wood bearings to other purposes in machinery, and he will be happy to communicate the results to the Institution on a future occasion.

The general results at present appear to point to the use of a plentiful supply of water, to carry off the heat caused by the friction of the bearings; and in the cases where this can be accomplished thoroughly, so as to carry off the heat as fast as it is generated, a brass journal revolving in hard wood bearings is practically perfect, showing no perceptible wear under a much more severe pressure than is usually met with in machinery. The two rubbing surfaces appear in reality to run without any lubricating material between them, and the water acts merely as a conductor to carry off the heat as rapidly as it is produced.

One other application of the wood bearings may be mentioned, which has been practically tried, and found very advantageous. The bearing which receives the thrust or propelling effect of the screw in the direction of the vessel's motion is formed of a series of collars on the shaft, running in corresponding grooves in the brasses, which have been found to wear very seriously, in a similar manner to the main bearings of the screw-shafts. The thrust-bearing of the *Himalaya*, which is shown in Fig. 8, had the brasses worn away longitudinally nearly three-quarters of an inch at each collar, and this was repaired by the engineer whilst on the voyage, by putting in a set of rings of lignum vitæ as an experiment, filling up the worn space, as shown in the upper half of Fig. 8. The wood was merely sawn into half rings, the lower pieces being slipped in from above, without lifting the shaft from its bearing. This plan answered completely, and no perceptible wear was found in the wood rings after the voyage home, the original saw marks not even being effaced; and the bearing proved so satisfactory, although only temporarily constructed, that the vessel has gone to sea again without any alteration. In this case the wood bearing was allowed to work most of the time with oil alone as a lubricating material.

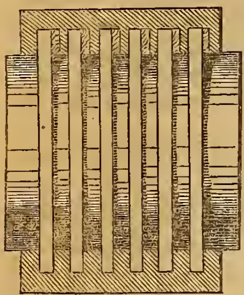


Fig. 8.

Of the various kinds of wood that have been tried in the experiments, lignum vitæ appears to be very satisfactory, and nearly as good as any, and it has the practical advantage of being less expensive, and readily obtainable.

TABLE OF EXPERIMENTS ON FRICTION OF BEARINGS.

Description of Bearing.	Area of Bearing.	Total Pressure.	Pressure per sq. in.	Time of Running.	Result of Experiment.
	sq. in	lbs.	lbs.	min.	
Brass on Brass	$\frac{1}{8}$	448	3,584	15	
Box on Brass	1	560	560	10	Marks not out.
Box on Brass	$\frac{1}{8}$	448	3,584	5	Not cut.
Box on Brass	$\frac{1}{8}$	560	4,480	5	Not cut.
Box on Brass	$\frac{1}{8}$	560	4,480	5	Not cut.
Box on Brass	$\frac{1}{8}$	672	5,376		Cut and abraded; side grain.
Box on Brass	$\frac{1}{8}$	672	5,376	5	End grain; not cut.
Lignum Vitæ on Brass...	1	672	672	15	Scratches made with tip of knife not touched.
Lignum Vitæ on Brass...	$\frac{1}{8}$	560	4,480	5	Cut a little.
Brass on Brass (salt water)	1	448	448	30	Little or no cutting.
Brass on Brass (salt water)	$\frac{1}{8}$	448	3,584	6	
Brass on Iron	1	448	448	5	Cut.
New Brass on Iron	1	560	560	10	Cut.
Brass on Iron	1	675	675	60	Cut and abraded.
Brass on Iron	$\frac{1}{8}$	560	4,480		Would not revolve; seized and stuck fast immediately.
Babbitt's Metal on Iron..	$\frac{1}{4}$	400	1,600	8	Rolled out sideways.
Kingston's Metal on Iron	$\frac{1}{4}$	400	1,600	6	Rolled out sideways.
Box on Iron	1	448	448	30	No perceptible wear.
Box on Iron	$\frac{1}{8}$	448	3,584	19	
Box on Iron	$\frac{1}{8}$	448	3,584	5	But little worn.
Lignum Vitæ on Brass...	1	560	560	10	Mark not out.
Lignum Vitæ on Iron....	1	1,250	1,250	2,160	No signs of wear; original slight scratch not out.
Lignum Vitæ on Brass ..	$\frac{1}{4}$	1,000	4,000	5	No injury.
Snake-wood on Brass	$\frac{1}{4}$	1,000	4,000	5	No injury.
Cam-wood on Brass......	$\frac{1}{8}$	1,000	8,000	5	No injury.

Mr. F. P. Smith stated that, in the unavoidable absence of Mr. Penn from illness, he had attended the meeting in his stead, and would be able to give any further explanation that might be desired upon the subject, as the experiments upon the wood bearings had been conducted under his own superintendence. He exhibited a number of specimens of bearings that had been experimented upon, consisting of different kinds of wood, and also of ivory, brass, and white metal, and said that the experiments would have been conducted further, as had been suggested, had time allowed; but the bearings of the screw-shafts in the war steamers that were under consideration were wearing away so fast, that Mr. Penn was glad to be able to arrive at a practical conclusion at once, as to the mode of stopping the evil that had been the special object of the inquiry, particularly as the results of the experiments, so far as they had been carried out, had proved so much more satisfactory and definite than could have been anticipated. The pieces of wood that had been used for trial were apparently insignificant, and their small size might cause the experiments to be looked upon as not sufficiently practical; but it had been found in the first trials that a pressure of 1000 lbs. per square inch on a piece of wood of one square inch area would not wear out the scratch of a pin, after running twenty-four or thirty-six hours; and the only available method at the time of increasing the pressure per square inch had been to reduce the size of the pieces of wood, retaining the same weights in the apparatus with which the experiments were made. The slips of wood of 1 in. length had accordingly been reduced in width to 1-4th in., in the expectation that a few minutes would suffice to give a definite result, but no wear could even then be produced; the area was then reduced to 1-8th sq. in., and still no abrasion took place under a pressure of 1,000 lbs., or 8,000 lbs. per sq. in.; the experiment was limited to this pressure by the slipping of the strap upon the pulley by which the shaft was driven. The little bit of wood used in this experiment had been left running for three hours at a speed of 260 ft. per minute, and had been tried in both fresh water and salt water, the latter salter than the sea, with no difference in the result. A brass bearing that had been driven at the same speed had been cut immediately at a pressure of 220 to 231 lbs. per sq. in., so remarkable was the difference between wood and brass; and Babbitt's soft metal, Kingston's metal, and other mixtures, had also been tried, but were not capable of working under a pressure at all approaching that admissible with the wood bearings. Several soft woods had been tried, all of which stood well; and among them poplar, which was a very soft wood, stood a heavy pressure with very little wear. It was the intention of Mr. Penn, at the earliest opportunity, to try a second series of experiments, in a more complete manner, carrying them out, if possible, to the limits in each case of the material tested. The test to which the wood bearings had been subjected in the *Himalaya* was the severest to which it was possible that they could be exposed in practice. In this vessel, the screw was made without any provision for drawing it up, and had accordingly no after-bearing in the rudder-post; the weight of the screw was $11\frac{1}{4}$ tons, or 13 tons with the overhanging portion of the shaft, and the bearing being 18 in. diameter, and 4 ft. length; the pressure was about 60 lbs. per sq. in. The wood was applied in twenty strips, each 4 ft. long and 3 in. wide, fitted close together round the inner circumference of the bush, the edges being bevelled so as to leave a groove nearly 1 in. wide between each of the strips of wood, for the water to flow through. After running 20,000 miles with the wood bearings the vessel had occasion to change her screw, thus affording a good opportunity for examining the condition of the bearings, and it was found that the total clearance of the shaft in the bearing did not amount to 1-8th in. at the top, including the clearance which there must have been when originally fitted. The *Malacca* also had run 30,000 miles without any signs of wear in the wood bearings.

Mr. James Brown inquired whether the wood bearings had been applied to any rubbing surfaces, such as cross bar guides, in which the wear was caused by a reciprocating motion; and also whether any trial had been made of them for main shaft bearings.

Mr. Smith replied that they had not yet been tried for a reciprocating motion, but had been applied to the bearings of a crank shaft driving the machinery in Mr. Penn's factory. In this application, however, the wood had not proved superior to brass, and was attended with some inconvenience, as special provision was required to ensure a liberal supply of water to the bearings, otherwise the wood was speedily charred, and became useless. It had also been tried for the crank pin of the *Malacca* but was not found better than other bearings, such as soft metal; in such situations there were no means of maintaining the wood in a water bath to keep down the temperature, which appeared to be essential in the use of wood for bearings.

The Chairman observed that the hard wood specimens that were exhibited had got a fine polish upon their rubbing faces, and probably required to be kept always under water for that purpose. They appeared to have been dovetailed into the brass bush in every case, and this precaution would be necessary in order to prevent them from spreading laterally under great pressures.

Mr. Smith said that in the wood bearings considerable heat was generated with the very heavy pressures in the experiments, and the wood became so hot, although immersed in water, that it could not be touched with the hand, showing how rapidly the bearing would have heated, if the heat had not been continually carried off by the surrounding water. Oil had been tried instead of water, and gave no difference in the result, if used in a large quantity like the water, but it did not answer if applied only in the same quantity as to ordinary brass bearings, as there was then not enough to carry off the heat as fast as it was generated.

The Chairman observed that the complete immersion of the whole bearing in water appeared to be an essential element in the successful application of wood, and he suggested that in future experiments a thermometer should be applied direct to the wood or metal bearing under trial, in order to ascertain the exact temperature, as it was evident that this would be somewhat higher than that of the surrounding water, The same experiments might be made very serviceable to determine the relative friction of the various kinds of wood and metal tested. He inquired whether wood had been tried in different positions of the fibre, endways as well as lengthways of the grain.

Mr. Smith replied that it had been tried in all three positions, endways, in the direction of the fibre, and transversely to the fibre; but the experiments had not been continued long enough to test their relative value. He was inclined to think the end way of the grain was the best mode of applying wood, and this had been done by drilling a set of shallow holes in the bush, into which wood-plugs were fixed; but this plan was objectionable in practice, as the wood-plugs were liable to fall out when dry, and the readiest mode of application was flatways, that is, so that the friction would be transversely to the fibre; the latter method had been hitherto exclusively adopted in the wood bearings of screw-shafts, and the wood could be readily and quickly applied to existing bearings, by planing out dovetailed grooves in the brass bush. In the experiments, the heating of the brass and wood had been measured by the rise of temperature of the water in the trough, and the results had been very marked; with the brass bearing, under a pressure of 200 lbs. per square inch, the temperature of the two cubic feet of water rose to 120° or 130° in one hour, whilst with the wood bearing, under a pressure of 4,000 lbs. per square inch, the temperature never exceeded 90° after any length of time, the heat beyond that limit being dissipated as fast as generated.

Mr. Hawkes remarked that he had had an opportunity of seeing the *Himalaya*, immediately on her return from her first voyage, and on inquiring how the stern stuffing-box of the screw-shaft was kept constantly tight, was told that it was not found necessary it should be kept tight, and it was even preferable to have it loose, allowing the water to flow through freely; the vessel had indeed made part of the voyage with the stuffing-box gland entirely removed, the water running through in a large stream, and being pumped out by the bilge-pump, and the result had been successful in keeping down the temperature of the bearings. He inquired how much water was allowed to run through with the wood bearings, and whether any extra pump was generally required to remove it.

Mr. Smith said that the gland was frequently left loose to allow the water to flow through, about as much water running in as would fill an inch pipe; this water was ordinarily left to run into the bilge, and pumped out by the bilge-pump, without the provision of a special pump. He might mention that in one instance, where the brass bearing was cutting severely, he had observed that the water running from the stuffing-box was impregnated with fine brass scales, to such an extent that 7 ounces were caught in a couple of hours.

The Chairman remarked that the paper contained much interesting and important information, and he hoped Mr. Penn would continue the experiments under different circumstances of speed and pressure, and with dry wood as well as under water, and would communicate the further results to the Institution at a future meeting. He proposed a vote of thanks to Mr. Penn, and also to Mr. Smith, which were passed.

THE PUMPING ENGINES OF THE WOLVERHAMPTON WATERWORKS, WITH SOME REMARKS ON WATER PUMPING.

By Mr. Henry Marten, of Wolverhampton.

Paper read before the Institution of Mechanical Engineers, January 30, 1856.
W. Fairbairn, Esq., F.R.S., in the Chair.

The engines described in the present paper, and of which drawings have been presented to the Institution, have been erected and at work now some years. They consist of a pair of engines at Tettenhall, constructed from the designs of Mr. Thomas Wicksteed, M.I.C.E., and erected in 1847 by Mr. James Kay, of Bury; and also an engine at Goldthorn Hill, constructed, in 1851, by Messrs. Hawthorn, of Newcastle-on-Tyne, members of this Institution.

The engines at Tettenhall are single direct-action non-condensing engines, and are shown in the general view, Fig. 1, Plate lxxxi., to a small scale, and in detail to a larger scale, in Figs. 2 to 8, Plate lxxxii.* The cylinders, A A, are 36 in. in diameter, and 9 ft. 6 in. stroke. The plunger-pumps, B B (Fig. 5), are 13 in. in diameter, lifting about 300 ft. The steam is admitted to the cylinder at a pressure of about 35 lbs., and cut off at 2-3rds of the stroke. The boilers are cylindrical, two in number, 26 ft. long and 6 ft. in diameter, with two tubes in each, 25½ in. in diameter, and internal fires. The flame from each fire-place passes along the tube, thence round to the front again by the side of the boiler next to its tube, and thence the two, uniting, pass along the bottom into the chimney.

The boilers were originally constructed with only one flue in each, of 3 ft. 9 in. in diameter: but it was found that the steam space was much too small for the size of the cylinders, and that the great draught of steam from the boiler at each stroke of the engine, and the consequent irregularity of pressure, so deranged the tube as to cause a constant leakage at the angle irons at each end. It has been found in practice that the two smaller tubes are in every respect preferable to the single one, as they allow more steam room, better heating surface, and afford convenience for cleaning all round under the bottom; and by permitting the water-level to be nearer the centre of the boiler-shell, they admit of a larger water surface for the delivery of the steam as it is generated in the water, so that the ebullition is less violent, and the formation of steam more rapid.

The boilers are covered with loam or moulding sand to a depth of about 6 in. over the top. This substance, which should be protected by a roof from being blown away, is found to be a very good non-conductor, very little heat radiating through it to the upper surface. It has also this advantage over nearly all other materials employed for the same purpose—that no condensation can take place in it within 2 or 3 in. of the boiler-plates, since for that distance it forms a sand-bath as hot as the steam, which, in the event of any leakage, blows through it dry, and consequently no corrosive action upon the plates can take place. Condensation cannot occur until at a distance of 3 or 4 in. from the plates,

* Plates lxxxi. and lxxxii. will be given in our next Number.

spreading thence very gradually with the escape of the vapour towards the surface of the sand, where a moist patch is observed, indicative of what is going on below. With a material of this description, any portion of the boiler-top can be uncovered with a shovel and examined at once. For the purpose of experiment at Tettenhall, steam blows at two places in the boilers covered in this manner were suffered to remain unrepaired for a couple of years, in order to try the effect fully, and the result was an entire absence of corrosive action as described above. In the opinion of the writer, loam sand is much preferable for this purpose to any other material, provided always that it is protected by a roof or covering. It is much cheaper than felt, brick, or iron casing, and the plates are much more readily inspected than with the latter coverings. It is also much superior to furnace ashes, cinders, or riddlings, which are often placed over boilers, as these substances frequently contain acids and other chemical impurities, which, on being brought into contact with waste steam, act very injuriously on wrought-iron; in some situations the author has seen plates nearly eaten through from improper coverings of this description.

In the pump-work, shown in Figs. 5, 6, and 7, there is little requiring special notice: the valves are ring-valves, rising on a centre spindle, as shown in Fig. 8; they are of cast-iron, galvanised, beating on wooden faces. Originally they beat upon a mixture of lead and tin, but this soon became loose in the seating and leaked; oak was then tried, but the acid peculiar to this wood corroded the cast-iron, so that these beats were obliged to be discontinued. Lancewood, box, and beech have also been tried, but nothing answers so well as holly, which is now employed, and continues to work well.

The area of the suction-valve, C, is 325 sq. in., being about $2\frac{1}{2}$ times the area of the plunger, and that of the delivery-valve, D, is 163 sq. in., or about $1\frac{1}{3}$ times the area of the plunger. The enlargement of the suction-valve to this extent is found to be very serviceable where the velocity of the plunger is likely to be great in the ascending stroke.

The steam-valve, E, the equilibrium-valve, F, and the exhaust-valve, G, are of gun-metal, and on the double-beat construction. Their areas are as follow:—

Steam-valve . .	50 sq. in.	=	1-20th of area of cylinder.
Equilibrium-valve	50 „	=	1-20th of area of cylinder.
Exhaust-valve .	78 „	=	1-13th of area of cylinder.

The piston-rod and pump-rod are connected with a cross head, H, working on V slides attached to the supporting columns, I, Figs. 2 and 3. The plug-rod, K, and the valve motion are worked from a slight wrought-iron beam, L, under the cylinder floor, connected at one end to the cross head, H, and at the other end slung to parallel links. The feed-pump, M, is also attached to this beam. The water for the feed is passed through a heater, N, situated in the corner of the engine-house, and formed by an enlargement of the waste steam-pipe, 1 ft. 6 in. in diameter, along the centre of which, for some distance, the feed-pipe is conducted, occupying about 2-3rds the area of the heater.

The engine is regulated by a water cataract governed by a small ratchet-wheel and screw. The number of strokes per minute varies from 3 or 4 to 10 or 11, the average speed of the piston being 130 to 140 ft. per minute; the quantity of water delivered per stroke is 56 gallons. The area of the plunger is 132 sq. in., and the pressure on the bottom of the plunger is 130 lbs. per sq. in., making a total dead load of 17,160 lbs., equal to a dead pressure of $16\frac{3}{4}$ lbs. per sq. in. on the surface of the steam piston.

These engines are working for their kind at a fair duty, performing about 27,000,000 lbs. lifted 1 ft. high per minute, with a consumption of 1 cwt. of the small common slack of the neighbourhood. With Newcastle or Welsh small coal they would perform a duty of 36,000,000 lbs.

The engine at Goldthorn Hill, shown in the general view to a small scale, Fig. 9, Plate lxxxii., is given merely as a sample of a good useful pumping-engine fitted for this neighbourhood. It is a low-pressure condensing beam-engine; the cylinder is 48 in. in diameter, with an 8 ft. stroke; the boilers are 30 ft. long and 7 ft. in diameter, with two tubes, 2 ft. in diameter beyond the furnace, and 2 ft. by 2 ft. 4 in. at the fire-places. The pressure of the steam is about 15 lbs. per sq. in. The boilers are clothed with felt and wood lagging, which was completed before the experiments with loam sand had been tried.

To avoid the almost constant trouble which arises from leakage at the steam-valves on the boiler-tops from the expansion and contraction of the main range of steam-pipes, Mr. Hawthorn suggested that the main steam-pipe should be conducted to the steam-chest with a quadrant curve, as shown in the plan, Fig. 9, so as to allow the two extremities connected with the steam-nozzles a considerable amount of expansion and contraction, without a thrust sufficient to break any joints; and the writer has pleasure in stating that this arrangement has been completely successful, as there has not been the slightest leak either at the nozzles or steam-chest. This arrangement is useful and efficient where there is one steam-pipe leading off from between two boilers; where, however, the steam-pipe leads off from one side, or where there is a range of more than two boilers, it is not applicable; and in these latter cases the writer has found no expansion-joint so simple and effective as the wrought-iron diaphragm joint, consisting of a couple of circular wrought-iron plates, about $2\frac{1}{2}$ times the diameter of the pipe, bellied about 3 in., and rivetted together at the outer rim and to flanges on the main range of steam-pipe.

There is another point of detail in connexion with the boilers to which the writer would wish to call attention, as it is useful, though frequently overlooked. The hot and cold feed and blow off are all led into and out of the boiler through the same pipe; this arrangement avoids the numerous holes usually cut into boilers for these purposes, and any impurity which may enter the boiler with the hot and cold feed is deposited in close proximity of the blow off. In the present instance, the pipe is of wrought-iron, and is rivetted on to the underside of the front end of the boiler, and the arrangement of the valves is somewhat similar to those of a bath, where the hot, cold, and outlet-valves all take off the same pipe.

It is also important that the feed should enter the coldest portion of a boiler which, from the action of the currents in those with internal flues, is just under the fire-grate. When attention is not bestowed on this point, it frequently happens that seams and rivets leak from the sudden changes of temperature to which they are liable.

The boilers are flat-ended and have no stays, but there are three stout T irons rivetted on to the flat plates forming the ends, so as to stiffen them against the pressure. This remark applies also to the boilers at Tettenhall, which are flat-ended, with T irons of the same description, working under a pressure of 35 lbs. per sq. in.

The writer's experience has led him to the conclusion, that, as a general rule, and as far as circumstances will possibly permit, all boilers should be so constructed as to require no artificial support from stays; these tend to pull a boiler out of shape, loosen rivets, and are difficult effectually to fasten or repair; flaws are not readily detected in them, and often when their services are most required they give way from hidden corrosion, or else they strain the boiler so as seriously to damage it, if not fixed exactly in the direction of the line of tension.

The pumps of Goldthorn Hill draw the water from a well about 90 yards deep, and this depth is divided into two lifts of about 45 yards each; the diameter of the bottom working barrel is 14 in. and that of the top $13\frac{1}{2}$ in. The valves are ring-valves of gun-metal, with gun-metal seats. The average speed of the piston is 100 ft. per minute, and the quantity of water raised per stroke is 48 gallons; the total dead pressure is 19,305 lbs., equal to 130 lbs. per sq. in. of area of the working barrel, and to $10\frac{1}{2}$ lbs. per sq. in. of surface of the piston. The steam is cut off at about half-stroke; the steam, equilibrium, and exhaust valves are double-beat gun-metal valves, and their sizes are as follow:—

Steam-valve . .	51 sq. in.	=	1-36th of area of cylinder.
Equilibrium-valve	51 „	=	1-36th of area of cylinder.
Exhaust-valve .	64 „	=	1-28th of area of cylinder.

The duty of the engine averages about 40,000,000 lbs. raised 1 ft. high per min. with 1 cwt. of slack.

The Tettenhall engines deliver the water over a stand-pipe 180 ft.

high, whence it flows by its own gravitation to the town. The Goldthorn Hill engine delivers through an air vessel into two covered reservoirs lying near the engine, and raised about 20 ft. above the top-lift, and holding together 1,500,000 gallons. The reservoirs are arched over, and covered with 2 ft. of soil, for the purpose of preventing vegetation and variation in the temperature of the water when exposed to the atmosphere, and this end is answered well, the water remaining for months at the same temperature, and perfectly clear and free from all vegetable or animal impurities. The reservoirs are prevented from being overfilled by a self-acting check-valve, shown in Figs. 10 to 13, Plate lxxxii., which shuts against any supply beyond a certain limit, so that the man working any pumping engine at a distance at once knows when his work is done. The valve is so arranged that immediately the engine ceases to work the supply to the town is maintained from the reservoir through the flap valves, O, underneath the self-acting stop-valve, P, which open immediately there is any requirement for the supply to the town.

The object of a stand-pipe is that the water may be always delivered from the engine over one uniform height, and consequently of one uniform pressure on the engine, whatever varying circumstances may affect the delivery after the water has once passed the top of the stand-pipe. Thus far it is useful, as the engine can always work under a defined pressure; but it is rather a costly and unsightly mode of attaining what in practice is found to be an unnecessary degree of perfection; since, with a tithe of the cost, all the necessary safety can be procured by pumping into an air vessel with a check-valve on the delivery side; so that in case of a pipe bursting, or any sudden diminution of pressure taking place, it would be impossible for the engine to "go out of doors" at more than a certain regulated speed, by the partial contraction of the area of discharge through the self-acting movement of the check-valve. Unless the stand-pipes are carefully cased in winter, they are in great danger of being frozen, and very serious consequences have arisen from this cause. There is also a drawback with them, on account of the great weight of the column of water which has to be set in motion from a dead stand at each stroke of the engine.

ON THE IMPROVEMENT OF RAILWAY LOCOMOTIVE STOCK, AND THE REDUCTION OF THE WORKING EXPENSES.

By Daniel Kinnear Clark, Assoc. Inst. C.E.

Abstract of a Paper read at the Institution of Civil Engineers, May 20, 1856.
Robert Stephenson, Esq., M.P., President, in the Chair.

It was stated that the design of the paper was to discuss the locomotive engine physiologically;—to consider some departments of practice which appeared to be in a transition state;—to endeavour to indicate how far, in some respects, the locomotive, even in its present advanced state of existence, was susceptible of improvement, and to form some estimate of the pecuniary advantages thus derivable. The three elements of the locomotive,—the boiler, the engine, and the carriage,—were considered successively.

With respect to the boiler, the fuels in use, in this country, were stated to be coke and coal. The author had, in a previous paper, shown, by mechanical analysis, that the combustion of coke in the locomotive was practically complete; and he adduced, in corroboration, the results of a subsequent chemical analysis of the gases of combustion, by M. Ebelmen, in the engines of the Paris and Lyons Railway. In the combustion of coal, which consisted chiefly of carbon and hydrogen, the production of smoke was ascribed to the presence of the hydrogen, which had a stronger affinity for oxygen than carbon had, and thus precipitated the carbon particles raised in union with it, in the form of smoke; and it was maintained that, to effect the consumption, or prevention of smoke, two conditions of supply must be observed,—a sufficiency of oxygen, and a sufficiently high temperature. For these conditions, it was argued that, in locomotive practice, strength of draught, and a means of equalising the temperature, were necessary to neutralise the evil of intermittent firing, and the unavoidable fluctuations of temperature.

The author adduced in evidence the results of trials made by him in 1850-51, and by Messrs. Woods and Marshall, in 1854, which showed, that in the prevailing type of boilers, the evaporative powers of good coal and good coke were as 2 to 3: coal doing mechanically just two-thirds of the duty of coke. He proceeded to give an account of recent trials made by him, in the beginning of this year, with the *Canute* on the London and South Western Railway, one of Beattie's passenger-locomotives, planned expressly for the combustion of coal and the heating of the feed-water. A pile of fire-bricks, through which the products of consumption must pass, was deposited in a combustion-chamber joining the fire-box and the tubes, to act as an equaliser of temperature. The hind compartment of the fire-box, also, was arched over with fire-bricks. The heating apparatus was in two parts,—the condenser outside, which acted by throwing the feed-water in jets amongst the exhaust steam,—and the superheater inside the smoke-box, through which the feed-water was also passed just before entering the boiler. The cylinders were 15 in. diameter, with a length of stroke of 21 in.; driving wheels, $6\frac{1}{2}$ ft.; fire-grate area, 16 sq. ft.; heating surface, 769 sq. ft.; and the weight of bricks was $5\frac{3}{4}$ cwt. It was found that in the *Canute* the prevention of smoke was completely attained with ordinary care and attention, that the evaporative power of the coal was materially improved, and that the heating apparatus was decidedly beneficial. With the regular express trains, the following results were obtained:—average express train, of $10\frac{1}{2}$ carriages, estimated at 66 tons weight; average speed, excluding stoppages, 34 miles per hour; water evaporated on duty, 82 cubic feet per hour of the time the steam was on the piston; corresponding consumption of coal, 547 lbs. per hour, and 15 lbs. per train-mile; water evaporated per pound of coal, 9·35 lbs.; average temperature of feed-water, 187° Fahrt. Special train, of 28 carriages, weighing 203 tons; average speed, $30\frac{3}{4}$ miles per hour; water evaporated as before, 130 cubic ft. per hour; coal, per hour, 915 lbs., and per train mile, $28\frac{3}{4}$ lbs.; water evaporated per pound of coal, 8·87 lbs.; temperature of feed water, 212° Fahrt. It was argued that on Beattie's system an economy of 36 per cent. of coal was effected in comparison with ordinary engines burning coal; and that this system was on a footing of equality with coke-burning engines, in evaporative efficiency of fuel, weight for weight.

The water supplied to locomotive-boilers was stated to be generally impure, mechanically, or chemically, and to affect very injuriously the durability of the engine, reducing, in one case, the durability of the tubes from eight or nine years with soft water, to three years with hard water. The loss by priming with bad water was shown to be considerable. It was concluded that the water supplied to locomotives should be previously purified, chemically and mechanically, in large tanks or reservoirs.

With respect to the engine proper, the author maintained that the link-motion was a sufficient and satisfactory expansion-gear, that its merits were not appreciated, and that in the ordinary practice of expansive working in locomotives the steam was not cut off earlier than at 40 to 50 per cent. of the stroke; but that with proper arrangements, it might be cut off at one-fifth. He argued also that the steam should be superheated and the cylinders perfectly protected, and that the slide-valves should be balanced.

With respect to the carriage, a resumé of the early and current practice of engine builders was given, from which it appeared that the system of six wheels, with central drivers, was the prevailing practice. It was argued, that this system was best adapted to secure the main objects in the carriage,—a sufficiency of driving weight, and free and steady running at high speeds, with the important proviso that the revolving and reciprocating masses of the pistons and cranks and their connexions should be balanced in the wheels. Evidence was adduced in proof of the economy of fuel effected by a correct equilibration of the engine.

In conclusion, an estimate was formed of the economy of working expenses due to the improvements described, on the assumptions,—first, that the consumption of fuel was an index to the working charges generally of the locomotive stock; second, that the average costs per ton of coal and coke, for locomotive purposes, were as two to three generally; and third, that the feed-water supplied to boilers was generally impure.

The following was an abstract of the successive items of economy of working charges, separately estimated :—

By the successful substitution of coal for coke	33 per cent.
By efficiently heating the feed-water . .	15 „
By the use of pure feed-water	10 „
By protecting the cylinders, and superheating the steam	10 „
By increased expansive working . . .	25 „
By the correct equilibration of the engine .	10 „

The gross resulting economy would then be represented, not, of course, by the direct sum of these per-centages, but by the result of the successive reductions obtainable by their successive application. Thus, after making the first deduction of 33 per cent., there would remain a balance of 67 per cent. to be operated upon for the second deduction, which was 15 per cent.; but 15 per cent. of 67 was equivalent to 10 per cent. of the original quantity, aud would leave 67—10=57 per cent.; the third deduction to be made was 10 per cent. of 57, or 5·7 per cent. of the original, leaving 51·3 per cent. as the balance to be operated upon for the next deduction. Continuing the operation in this manner, the gross resulting economy would amount to about 70 per cent. of the existing average working charges. Allowing for contingencies in the estimate, 50 per cent. was adopted by the Author, as the probable average saving that might be effected in the consumption of fuel, and generally in the working charges of the locomotive stock of the railways of the United Kingdom.

The average apportionment of the receipts on the railways of this country was stated to be as follows, on the authority of Mr. Chattaway :—

Working charges	46½ per ceut.
Interest on guaranteed capital . . .	28½ „
Dividends in respect of ordinary shares .	25 „
Gross receipts	100

Also, that the average cost of locomotive power was 29·3 per cent. of the receipts; consequently, the saving, estimated by the Author, would be one-half of this, or 15 per cent. of the receipts, and would raise the available dividends from 25 to 40 per cent. of the receipts; or from the average on ordinary share capital, stated by Mr. Chattaway as 3·14 per cent., to a dividend of 5 per cent. per annum.

ON THE BRIDGES AND VIADUCTS OF THE PRESENT DAY.

By Mr. John Clayton, A.R.I.B.A.

Paper read at the Ordinary General Meeting of the Royal Institute of British Architects, May 19th, 1856.

There are few public works (commercially speaking at least) of greater interest or importance than bridges and viaducts. The necessity of good roads of communication from one part of a country to another, and the impossibility of completing them without erecting bridges over streams, and viaducts over valleys, have given rise not only to the works of the present day, but also to those stupendous monuments of antiquity which have been handed down to us. With the magnificent bridges, viaducts, and aqueducts of the Romans every architect must be well acquainted, and it is indeed not long since that ancient Roman roads and modern British railways were compared by a very able authority before the Institute. In consequence of the immense extension of the railway system during the past thirty years, a more extensive field of bridge-building has been opened than at any previous period. The fact that in 1852, 15,000 miles of railway had been constructed in Great Britain alone, and that these required, on an average, three or four bridges per mile, will give a total of 50,000 bridges, large and small.

In speaking of the bridges and the viaducts of the present day, it will be hardly necessary to observe that their great and striking peculiarity is to be found in the use of iron; and though, as architects, we may be impressed with the superior dignity and proportions of stone bridges, it must be granted that iron has many advantages compared with either stone or timber, as it is much lighter and more economical in the first outlay than the former, and more durable than the latter. It must not, however, be forgotten that although iron construction may be considered the great invention and distinguishing peculiarity of modern times, there are also some very fine works in stone, brick, and timber. In the two former, however, no progress worthy of peculiar notice has been made, bridges of larger span having been executed by the Romans centuries ago. The largest span in stone executed in England is that over the Dee, of 200 ft.; but ancient examples are recorded to have been from 50 to 100 ft. wider, which, with reference to the age when they were executed, must have called for a comparatively greater amount of skill. It is in iron, therefore, with respect to the span, that the great merit of modern works consist: the changes in the different modes of applying this material have been gradual and progressive, and very similar to, though somewhat more rapid, than the changes in the differeut styles of architecture. The first iron bridge was erected about sixty years ago, and partook of the character of its predecessors in stone, being formed of cast-iron voussoirs, or wedge-shaped blocks put together in ribs. From that time to the present there has not been much improvement in the construction of this class of iron bridges, and the span has only increased from 200 to 240 ft., which would appear to be the proper limit. Soon after the introduction of the cast voussoir principle, cast-iron beams were used for small spans of 50 ft., which eventually, by combination with wrought-iron trussing, reached as far as 100 ft. The greatest improvement was the formation of girders entirely of wrought-iron, which soon followed the production of rolled plates and bars of different forms and sections. This, in a few years, led to the execution of spans of 460 ft.; the largest of rigid roadways with a level headway beneath, yet constructed. In suspension bridges, spans on this principle have been executed of upwards of 1,000 ft. But as these, from their vibration, are quite unfit for the passage of heavy weights in rapid motion, they will not be treated of on the present occasion.

Cast-iron bridges may be classed as follows :—the Arched Rib, the Trabeated, aud the Combination Girder. Wrought-iron bridges consist of the Tubular Girder, the Tubular Bow Girder, the Large Tube, and Lattice Girders, with several varieties of combination.

The first iron bridge constructed in England is that over the river Severn, near to Colebrook Dale. The design appears to have originated with Mr. Pritchard, architect, about the year 1773, and the works were completed in 1779. In this bridge five arched ribs of cast-iron support perpendicular spandril pieces, which carry the roadway. The ribs are nearly semicircular, and have a span of 100 ft.

Sunderland Bridge, over the river Wear, the next cast-iron bridge erected, was designed by Mr. Rowland Burdon, in 1792, to whom a patent was also granted, for "a certain mode or manner of making, uniting, and applying cast-iron blocks to be substituted in lieu of key-stones in the construction of arches." This bridge consists of six arched ribs of a segmental form, 200 ft. span and 30 ft. rise. Each rib is 5 ft. deep, and consists of 105 separate blocks.

Buildwas bridge, over the river Severn, by Telford, is like the foregoing,—a single arch, 130 ft. span, with 27 ft. rise. It consists of three arched ribs, 3 ft. 10 in. deep.

Boston bridge, by Rennie, is remarkable for the slightness of its rise, which is 4 ft., with a span of 100 ft.

Southwark bridge, also by Rennie, has the greatest span executed, that of the centre arch being 240 ft., and of the sides 210 ft. The rise of the centre arch is 24 ft., that of the side arches proportionate. The arches consist each of eight ribs, 8 ft. deep at the springing, and 6 ft. at the crown. Each rib is in fifteen pieces, cast of much larger masses than in the previous works.

The new bridge, Westminster, in course of construction, will also prove a valuable addition to this class of works.

Upon simple cast-iron beams it will not be necessary to say much. The first application of this material as a beam is due to Boulton and Watt, after whom it was extensively applied in construction by Sir R. Smirke. Although useful in buildings, its fragile and treacherous character renders it hazardous for railway purposes. Capable of bearing a large amount of dead weight, it cau be easily broken by a cross blow or the sudden shock of a passing train. Its span has been limited to 40 or 45 ft., and this only under very careful treatment.

With the view of remedying the defects of cast-iron girders, recourse was had to trussing them with malleable iron. Owing, however, to the unequal expansion and coutraction of the two metals, and the fact that the two were seldom brought into action at the same time, the success of these beams has been very doubtful. They have been used in spans of 50 to 100 ft., but certain failures appear to have led to their disuse.

The Lea bridge was erected about ten years ago. The total length is 70 ft., or 66 ft. clear bearing. The girder was composed of two castings of a uniform depth of 3 ft., bolted together with wrought plates to the joints and trussing-bars.

Dee bridge, Chester, was the largest bridge of the kind. It crossed the river in three spans, and had a double line of rails with a pair of girders to each. The total length of each girder was 109 ft., or 98 ft. clear bearing. It had a uniform depth of 3 ft. 9 in., and was formed of three separate castings. Cast-iron plates, 13 ft. long and 3 ft. deep, were bolted over the top of the joints, and a set of trussing-bars was placed on each side of the girder. The thickness of the web or central part was 2⅛ in., the top flange 7 in. wide, the bottom 2 ft. The girders sustained the usual test, yet gave way under a much less load. The failure has been attributed to a variety of causes, but a not unfrequent one has been overlooked, viz., the manner in which the roadway was made to take its bearing on the girders. As a general rule, too much care cannot be taken to give the weight a uniform bearing in a vertical direction, on either cast or wrought-iron girders, more especially the former. Placing the planking or beam on the inside flange will, on the passage of every weight, cause a tilting, vibratory motion. If the roadway cannot be placed altogether on the top of the girder, it should be carried underneath it and suspended with plates and bolts.

Tubular girder bridges owe their origin to the manufacture of wrought plate-iron, which was first used in ship-building. Great improvements were soon made in the mode of joining and rivetting these plates, and the T, L, and double L iron, manufactured by Mr. Fairbairn, led to the great works which were carried out after its application to railway purposes.

The Liverpool canal bridge, on the Blackburn and Bolton railway, executed by Mr. Fairbairn, was the first application of these girders: the span is 60 ft. The Liverpool landing stage bridge, erected by Mr. Fairbairn for Sir W. Cubitt, spans the space between the pier and the floating pontoon in deep water. Its total length is 152 ft. and 142 ft. between bearings.

The Gainsborough bridge, erected by Messrs. Fairbairn for Mr. Fowler, crosses the river Trent at the angle of 50°. It consists of two spans, each of 154 ft. There are two girders to each span, carrying a double line of rails: the girders are of an uniform depth of 12 ft.: the top is strengthened with a double chamber 3 ft. wide by 1 ft. 3 in. deep: the width of the girder below is 2 ft. 6 in. The sides of the girder are strengthened by an arched rib of a double L shape, 1 ft. deep: the plates are 2 ft. wide and half an inch thick.

The Britannia bridge, by Stephenson, has been fully described, and it is only necessary to give chief dimensions. It consists of four spans, the two main 460 ft., the two side 230 ft., and it is 90 ft. clear of high-water mark. There is a tubular girder to each line of rails, the dimensions of which are 30 ft. by 14 ft. 6 in. The form of this tube is square, and it is stiffened at the top and bottom with small cells, which answer to the top and bottom chords of the lattice girder.

The high level bridge, Newcastle, also by Stephenson, forms a junction between several railways. It is remarkable for carrying a railway above and a roadway for street traffic below, and consists of six spans of 125 ft.: the extreme height is 125 ft., and there is a clear headway of 80 ft. above the water-line. The weight is carried by arches on the level of the roadway, the bottom of which is suspended from it. The piers measure 50 ft. by 16 ft., and are lightened by arches. The most striking and peculiar feature is seen from the roadway, which presents a series of dark arched ribs, with light bursting through the bars supporting the sides. The whole design is exceedingly good, and the exterior handsome.

Before entering upon the subject of lattice girder bridges, it it necessary to glance at the timber viaducts, as it is from them that the former derived their origin.

The most remarkable of these structures are the American. The greatest span is that over the Portsmouth river, 250 ft.; the greatest height that over Genesse river, 230 ft. As English examples we may mention Dinting Vale, with a span 120 ft. by 125 ft.; Landore, 109 ft. by 90 ft. Amongst the earliest wooden bridges are those designed by Palladio, three of which have 100 ft. span: two are framed on the ordinary principle of trussing, and the other on the arched rib or voussoir principle.

The Portsmouth river bridge is formed on the same principle as the last, with the addition of diagonal bracing to each voussoir. Don bridge, near Aberdeen, is composed of a strong arched rib, the spandrils between which, and the level roadway above, is a filling in of framing distributing the pressure. Schaffhausen bridge is similar in arrangement to the earliest American. The weight is carried by a series of raking-struts, which radiate from one or more points on piers or abutments; they are bolted to the top and bottom chords of the girder, and transfer the weight of the roadway at regular intervals to the piers.

The Portage timber viaduct, the loftiest and most interesting piece of timber work of the kind, crosses the Genesse river at an altitude of 230 ft. This work, designed by Mr. Silas Seymour, was commenced on the 1st of July, 1851, and completed in a period of only thirteen months and a half. The whole length is 800 ft.; the piers, 50 ft. apart, are formed of wooden trestles, standing on a base of stone 24 ft. high. The trestles are formed of timbers 14 in. square at the base, and 1 ft. at the top; the braces to the piers and girders are 6 in. by 12 in.: the number of vertical posts at the base is twenty-one, which diminish to fifteen at the top. Three rows of girders, 14 ft. deep, formed of diagonal braces, support the roadway. The cost of the bridge was £35,000; the quantity of timber 135,500 ft. It was estimated that a stone bridge would have cost seven times the amount, and that the interest would renew the whole three times as often as would be required. This may apply in America, but the economy of using timber is very questionable in England.

(To be continued.)

NOTES BY A PRACTICAL CHEMIST.

Bones Soluble in Water.—The phosphate of lime or bone earth has generally been rendered soluble for agricultural purposes by means of sulphuric acid. If, however, bone-dust is left for some time in contact with water, the liquid, on filtration, is found to hold phosphate of lime on solution. Water deprived of carbonic acid, by long-continued boiling, gives the same result. As the organic matter of the bones enters into decomposition the amount of phosphate dissolved increases. Hence, Woehler proposes to lay bone-dust in heaps during the summer, and keep it constantly moist.

Extraction of Pure Silver from Copper Alloys.—The alloy is dissolved in nitric acid, the excess of acid driven off by evaporation, the solution diluted with water, and the two oxides thrown down by carbonate of soda in excess with heat. The mixed carbonates are then heated with a solution of grape sugar, when the copper is deposited as sub-oxide, and the silver in the metallic state. After boiling for some time, the precipitate is filtered, and while still moist treated with a hot solution of carbonate of ammonia, which dissolves the copper, leaving pure silver. Carbonate of ammonia is added as long as the liquid turns blue, and the deposit washed by decantation.

Detection of Iodine in Mineral Waters.—Liebig has observed that fluids containing so small a quantity of metallic iodides as not to give a distinct blue colour with starch and nitric acid, may be made to re-act distinctly by adding a very-small quantity of an alkaline iodate along with sulphuric or muriatic acid. Neither iodic acid nor iodide of potassium alone colours starch.

Determination of Copper.—When the solution of copper contains no nitric acid, arsenic, or antimony, Fleitman precipitates with pure metallic zinc, removes excess of zinc by digestion with pure dilute sulphuric acid, washes the precipitate of copper with boiled water, and dissolves in an acid solution of pure perchloride of iron. The copper dissolves rapidly, yielding twice its equivalent of protoxide of iron, which is volumetrically determined by permanganate of potash.

If nitric acid be present, he adds ammonia in excess, filters off any precipitate, and throws down the copper from the ammoniacal solution by means of zinc shavings. This process is rapidly accomplished in a heated liquid. The deposit is freed from nitrates by washing, and from zinc by digestion in pure dilute sulphuric acid. The remainder of the operation is as above.

If arsenic be present, it is converted into arsenic acid; ammonia is added in excess, the arsenic acid is thrown down by sulphate of magnesia, and the filtered solution of copper treated as above.

Silvering Glass.—Liebig has discovered a process for silvering glass in the cold, suitable for the production of faultless optical mirrors. For this purpose 10 grms. fused nitrate of silver are dissolved in 200 cubic centims. of water, and ammonia is added until the solution becomes clear. This liquid is gradually mixed with 450 cubic centims. of a solution of potash of sp. gr. 1·05 (or of soda, 1·035). The blackish-brown precipitate formed by this addition is dissolved by adding more ammonia. Water is now added so as to bring it to 1·450 cubic cents. A weak solution of nitrate of silver is then dropped in until a strong grey precipitate is produced, and water is added so as to make up 1,500 cub. centims. Each cubic centimetre now contains a little more than 6·66 milligrms. nitrate of silver, or 4·18 of silver. To produce a clean mirror the liquid should contain no free ammonia.

The solution of potash or soda must be free from chlorides; pure carbonate of the alkali is dissolved in water and rendered caustic by pure hydrate of lime previously washed in distilled water. The solution is allowed to stand until perfectly clear. Immediately before the application of the silvering fluid, it is mixed with 1-8th to 1-10th its bulk of a solution of sugar of milk, containing 1 part to 10 of water. In silvering small convex or concave mirrors, a hook is attached to the back of the glass by a cement, so as to enable the glass to be suspended horizontally over a suitable glass, or porcelain saucer, with the surface to be coated about half an inch from the bottom of the vessel, and the fluid previously mixed with the solution of milk of sugar is poured in until the whole surface of the glass is immersed.

For preparing plane mirrors the author recommends vessels of gutta percha, cut out of a flat piece, so as to leave a margin of about an inch all round the glass. This is turned up, and the corners made watertight by the application of a hot knife. The glass is supported at about half an inch from the bottom of the vessel, by small cones of gutta percha at the corners of the vessel, and the silvering solution is then added. The glass turns black in a few minutes ; in a quarter of an hour it becomes bright, and the operation is complete when the liquid between the edge of the glass and the wall of the vessel is covered with a white coat of silver. A mirror of 1 met. square takes 2·21 grms. of silver. The rest of the silver is deposited in the bath and on the walls of the vessel. This is collected, and reconverted into nitrate of silver. The glass plate is taken out of the fluid, washed with warm distilled water, and dried in a warm place. Care must be taken not to injure the silver coating with the fingers whilst moist. When dry it is carefully polished with rouge and velvet. It need scarcely be added that the glass, before silvering, should be perfectly clean. The distance between the glass and the bottom of the vessel must be exactly equal throughout, or the coating of silver will be unequal in thickness, and will appear darker in those parts where it is thinnest. Bubbles of air adhering to the glass will also cause flaws. They may be displaced by moistening the surface of the glass previously with alcohol.

ANSWERS TO CORRESPONDENTS.

"T," with reference to Palmer's case, states that he has found small animals die, after a dose of acetate of morphia, with symptoms very similar to those produced by strychnia. A discussion of this question is more adapted for a medical journal.

"Hugo."—Coprolites are not likely to be found in such a geological formation.

"Z. R."—We know of no method for the artificial production of tartaric acid. It is not of frequent occurrence in the vegetable world.

ON THE EVAPORATIVE EFFICIENCY OF MARTIN'S VERTICAL TUBULAR BOILERS.

By J. Vaughan Merrick.

The machinery of the United States steamship *Susquehanna* has recently been thoroughly refitted and furnished with four new boilers of the above description, by Merrick and Sons, Philadelphia. The boilers are of iron, with brass tubes, and have the following general dimensions:

Length of each boiler, athwartships, 11 ft. ; breadth, fore and aft, 15 ft. ; length of vessel occupied by four boilers, 31 ft. 8 in.; breadth of ditto, and fire-room, 31 ft. The fire-room is between the two pairs of boilers, the furnaces firing athwartships, and the flues delivering into one chimney, each boiler having 1-4th of a steam-drum. Height of boilers, exclusive of steam-drum, 13 ft. 6 in.; height of ditto, inclusive of steam-drum, 15 ft. 10 in.; cubical space occupied by all the boilers and fire-room, being the content of a parallelopipedon included within the above circumscribing lines, throwing off the steam-drum, which is between decks, 13,240 cubic ft.; number of furnaces in all boilers, 20 ; breadth of ditto, each, 2 ft. 5 in.; length of ditto, each, 7 ft.; grate-surface area in all, 338 sq. ft.; number of tubes in all boilers, 5,480 ; length (or height), 36 in.; diameter (outside) of the tubes, 2 in.; heating surface in furnaces and back connexions up to tubes, 1,614 sq. ft.; heating surface in tubes, 8,508 sq. ft. ; heating surface in tube-boxes and connexions to smoke chimney, 1,581 sq. ft. ; total heating surface in all boilers, 11,703 sq. ft.; proportion of the same to grate area, 34·6 to 1·00 ; flue area or calorimeter between tubes in all boilers, 42 sq. ft. ; proportion of the same to grate area, 1 to 8 sq. ft. ; diameter of smoke chimney, 8 ft. ; diameter of ventilating chimney within, and concentric with it, 2 ft. ; area of annular space or chimney, 47·12 ; proportion of the same to grate area, 1 to 7·4.

The boilers have water-bottoms, with not less than 6 in. of water-space at any point ; back of the furnaces these bottoms rise to the back connexions : the tube-boxes are above the furnaces, and rise slightly to the front end of the boiler, where they enter the front connexions. The boilers are of 3-8th in. and ½-in. best American plates, double rivetted and caulked inside and out, throughout, and are well braced. The weight of all four, when empty, is 255,000 lbs. Their total weight, when filled to the working level, is 440,000 lbs.

To test the economical evaporative efficiency of this form of boiler, an experiment was made on the 13th of March last, in the presence of several engineers of the Navy, the conditions and results of which were as follow :

Two boilers only were used, and the dampers were nearly closed.

The coal used was anthracite, and of an inferior quality. The engines are fitted with Stevens' cut-off, which was adjusted and permanently fixed to cut off as follows :

Port engine, one end	3·88	Starboard engine, one end	4·60
" "	4·12	" "	3·35

Average per indicator-card, with full throttle ....3·97 ft.

Adding to this the average clearance at each end of the cylinder, and including, also, the steam-passage, &c., between valves and cylinder, equal to 23·820 cubic in., or the area of the cylinder by 6·05* in. of stroke, or ... ·504 ft.

Average length of cylinder, filled at each single stroke ....4·474 ft.

Preserving the same level of water in the boilers, and (as nearly as could be ascertained) the same quantity of coal in the furnace, or about the same fires, and maintaining the same pressure of steam, 4,200 lbs. of coal were consumed, and 1,615 revolutions made and noted by register, the duration of the experiment being 3 hrs. 57 min. During this time eleven double cards were taken on the two engines, which showed a mean pressure of steam entering the cylinders, during that part of the stroke over which steam was admitted, of—

Total pressure—Port engine, 18·99 lbs.; starboard engine, 21·81 lbs., of which (Pambour) the volume is 1,257.

Hence, the water evaporated during the experiment was as follows : the two cylinders being 70 in. diameter = 26·41 sq. ft. of area.

$$\frac{26\cdot71 \times 4\cdot474 \times 1{,}615 \times 4 \times 62\cdot5}{1{,}257} = 39{,}372 \text{ lbs. of water,}$$

which, being evaporated by 4,200 lbs. of coal, gave 9,137 lbs. of water per lb. of fuel.

The temperature of the hot-well was 89½°, and of the feed-water entering the boiler at (probably) 85°.—*Journal of the Franklin Institute.*

* This enormous amount is taken from actual measurement, and is in a great measure incident to the form of engines (inclined) with which the ship is supplied.

REVIEWS.

Practical Perspective. By R. Burchett. Chapman and Hall, Piccadilly.

This is an excellent hand-book for the student desirous of acquiring readily a sound practical knowledge of linear perspective—a vast deal of really useful information being communicated in the series of lectures which have been delivered by the author, as head-master of the Training and Normal School, Marlborough House, and are now published at a small price, as a course of twenty lessons, in a small, neatly printed and amply illustrated volume. The illustrations, too, are well chosen, being every-day, common-sense, familiar objects, and leading, in the first place, the student on by degrees to more difficult and composite subjects for the display of his proficiency in the study. And whilst the author, in the introduction, alludes to the number of books published and in use, treating of the same subject, we may with confidence, after going through *his* addition to the number, pronounce an opinion that a more practically useful treatise upon the subject cannot be found amongst the many that have gone before.

The author states :—"Notwithstanding the number of books in circulation on the science of perspective, it is repeatedly asserted that it cannot be learnt from books; and although this cannot necessarily be true, it is greatly to be feared that too many students find it true in their own individual cases. Perhaps this arises from two causes—First, the science of perspective, although in its fundamental principles *extremely simple*, demands from those employing it an application differing frequently with every subject, and presenting new features each time it is employed—an ability of application which can only result from a *thorough* understanding of those fundamental principles. Secondly, the books published on perspective may be broadly divided into two classes, the profound and abstruse, and the simple and unprincipled. The first treat the subject as an elaborate science, demanding for their comprehension a great amount of previously obtained knowledge, not often to be found amongst those most requiring a knowledge of perspective, and offering rather a large number of abstract laws than of practical applications of them. The second class appear to treat perspective rather as an art than as a science ; and in their great anxiety to avoid embarrassing their readers with science, forget to furnish him with PRINCIPLES ; supplying him instead with a number of RULES—many of which are needless repetitions of the results of the same principle or law; and yet these, numerous as they are, leave a great number of cases unprovided for—upon one of which the student stumbling, finds his fancied knowledge of perspective an ignis fatuus that has tempted him to a quagmire and then betrayed him."

And we entirely agree with him when he states with reference to his work:—

"It is proper to premise that the perspective here taught is such as artists practise and believe in; such as all who attempt to *draw* should know: that it does not meddle with curvilinear horizontal lines, does not assert that vertical lines converge, nor propose as exercises the painting of imitation cupolas upon flat ceilings, which require the spectator to lie upon his back on the floor to the detriment of clothes and the derangement of his head, in order to the realisation of the truth of the work. But on the contrary, it professes to believe that lines that are straight in fact should be straight in their representation; that the men forming a well dressed line of infantry would, if viewed under the conditions specified, *appear* to stand upright and not all converging in the direction of the central man, bearing in mind that the *appearances* of the *representations* of objects are subject to the same optical laws as the appearances of the objects themselves, and the exercises it proposes are such as may consistently be placed upon a vertical wall and examined at least without *physical* discomfort.

"It may not be out of place here to say a few words on the general value of a knowledge of perspective, it being too often considered necessary only to architectural draughtsmen, or to those artists who employ architecture in their pictures, and too often not possessed even by those.

"This, however, is a very grave mistake—the laws of optics are those which regulate the *appearances* of objects, the laws of perspective are the corollaries of those laws, and they govern the *representation* of the appearances of objects; all drawing is a representation of appearances, and how halting and imperfect must the work be when it is executed in ignorance of the very laws which should govern its production.

"The moment when a student ceases to draw from a flat copy and enters upon the study of solid forms, he commences the labour of translating *facts* into *appearances;* the laws of perspective govern this translation. At this stage how often is it found that the known facts of the object are at conflict in the student's mind with his conception of the appearances, resulting in a representation at discord both with appearance and fact: a knowledge of perspective would have removed this erroneous impression, would have reconciled this discrepancy; and one great value of perspective most undoubtedly is the power it imparts of *seeing correctly.* The laws of perspective abiding in the mind and guiding the hand in every line it may draw, even when an actual application of its rules would be as impossible as unproductive."

Analysis of Ornament. By Ralph N. Wornum. London: Chapman and Hall, Piccadilly.

Here is another of that useful class of works, which the system of education, adopted in the government schools of design, has been instrumental in producing. We have been induced to refer to this book, which is the production of Mr. Wornum, the Librarian of the Department of Science and Art, at Marlborough House, being an outline of a course of sixteen lectures originally prepared for the government schools of design, and delivered by him at Somerset House, illustrating the characteristics of styles and the history of ornamental art.

The subject has been treated in a comprehensive and masterly manner, the illustrations with which each chapter abounds are executed in excellent style on wood, by the female students of the wood-engraving class at Marlborough House. Every student in art should possess the work.

The Municipal Directory for 1856. Kelly and Co.

The want of such a directory was becoming felt just as Messrs. Kelly and Co. most opportunely bring out the above work. The changes which have taken place in the direction of parochial affairs, through the passing of the Local Management Act, has rendered it necessary that we should be correctly informed as to who are the persons entrusted with such very extensive powers as are granted under the Act, and such other information as to the officers, their districts, duties, hours of attendance, &c., as will be found invaluable by those engaged in various occupations in this great metropolis.

The work has been very carefully compiled from the most accurate sources of information, and is produced in a complete form at a low price.

LIST OF NEW BOOKS OR NEW EDITIONS OF BOOKS.

BURCHETT (R.)—Practical Perspective: the course of lectures on Linear Perspective delivered at the Training School, Marlborough House. By R. Burchett. Post 8vo, pp. 100, cloth, 7s. (Chapman and Hall.)

DEMPSEY (G. D.)—Ten Bridges, with Details. 4to, 10s. 6d. (Atchley.)

HAY (D. R.)—The Science of Beauty, as developed in Nature and applied in Art. By D. R. Hay. Royal 8vo. pp. 120, cloth, 10s. 6d. (Blackwood.)

TAUBERT.—On the Use of Field Artillery in Service, with especial reference to that of an Army Corps; for Officers of all Arms. By Taubert. Translated from the German, by Henry Hamilton Maxwell. 12mo, pp. 225, cloth, 1s. 6d. (Weale's Military Series.)

JOURNAL of the Royal Dublin Society. Published quarterly. No. 1 (Dublin), pp. 60, sewed, 2s. 6d. (Simpkin.)

BOURNE (J.)—A Catechism of the Steam-Engine in its various applications to Mines, Mills, Steam Navigation, Railways, and Agriculture; with Practical Instructions for the Manufacture and Management of Engines of every Class. By John Bourne, C.E. 4th edition. Part 1, 12mo, sewed, 6d. (Longman.)

BUILDER'S (The) PRACTICAL DIRECTOR; or, Building for all Classes. Containing Plans, Sections, and Elevations, for the erection of Cottages, Villas, Farm Buildings, Public Schools, &c., &c., with Estimates, Quantities, &c. With Plates and Diagrams. 4to, cloth, 36s. (Hagger.)

COTTON (A.)—Profits upon British Capital expended on Indian Public Works, as shown by the results of the Godavery Delta Works of Irrigation and Navigation. By Colonel Arthur Cotton. 8vo, sewed, 1s. (Richardson.)

CRESY (E.)—An Encyclopædia of Civil Engineering, Historical, Theoretical, and Practical. By Edward Cresy. New edition, with Supplement, 8vo, pp. 1,760, cloth, 63s. (Longman.)—Supplement separately, 8vo, pp. 104, cloth, 10s. 6d. (Longman.)

CUNDALL (J.)—The Photographic Primer, for the use of beginners in the Collodian Process. By Joseph Cundall. Illustrated with a Photographic Picture. 2nd edition. 12mo, pp. 32, sewed, 1s. (Low.)

DEMPSEY (G. D.)—Railway Stations, Engine Houses, Manufactories, Workshops, Warehouses, &c.; with full Working Drawings, Fireproof Construction Sections, Weights, &c., of Wrought and Cast Iron, applicable to every Class of Building. By G. D. Dempsey, C.E. Large Folio Plates, 4to, letterpress, 42s. (Atchley.)

GREGORY (W.)—A Handbook of Organic Chemistry; for the use of Students. By William Gregory. 4th edition. Post 8vo, pp. 640, cloth, 12s. (Walton.)

GREGORY (W.)—A Handbook of Inorganic Chemistry; for the use of Students. By William Gregory. 4th edition, corrected and much extended, crown 8vo, pp. 626, cloth, 12s. (Walton.)

LUNAR MOTION: Correspondence between the Astronomer Royal and Mr. Symons on this subject, with the Arguments on each side. Illustrated by Diagrams. 12mo, 1s. (Groombridge.)

SUTTON (T.)—The Calotype Process: a Handbook to Photography on Paper. By Thomas Sutton. 2nd edition. Post 8vo, pp. 94, cloth, 2s. 6d. (Low.)

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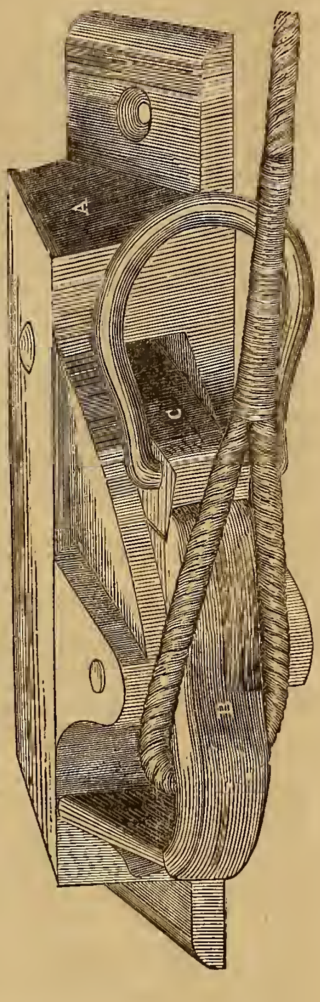
AMERICAN NOTES, 1856.—No. VII.

NAVIGATION.

Maskell's Slide-keel.—Mr. Thomas Maskell, of Franklin, La., some time since invented a mode of increasing the literal resistance of vessels by means of a slide-keel, nearly equal to the depth of the main-keel, which may be raised or dropped at pleasure without detention, and without interference either with the capacity of a vessel for stowage or with her strength. The slide is designed to be about 2 in. thick, of iron, and to maintain a parallel line to that of the keel, whether drawn up or lowered. The rods, by which it is raised up or lowered, may pass through an iron pipe inserted in the hole in the keelson, the pipe serving also as a stanchion. Under a beam, immediately aft of the mast, the slide is raised and lowered by means of a racket-wheel.

This arrangement was lately essayed in France in a steamer of light draught, designed for a route combining the requirements of sea with the restrictions of a canal; and the vessel, the *Laromiquere*, was 216 ft. in length, 33 ft. wide, and, when deeply laden, had a draught of 6 ft. The experiments proved highly successful.

Cadwell's Patent Dead-Eye.—The subjoined engraving represents a perspective view of Cadwell's improved Dead-eye, or Safety Draw-iron, for Canal Boats, for which letters patent were granted, November 14, 1854.



With the old arrangement of fastening the bow-line to the boat by slipping it over a hook or staple, constant attention was required to detach it, in case of its fouling with a passing boat, or when entering a lock; but by this improvement, the tow-line can be instantly detached, in either exigency, by the steersman, who, from being constantly on the look-out, is better capable of judging of the exact place and time when it is required than any one else can be.

It is, as will be perceived from an examination of the engraving, simple in its construction and operation, and not liable to be disarranged by use or accident. The tow-rope is retained in position by the lever, *c*, slipping into a catch in one of the tumbler, *b*, ends, and is disengaged by pulling a wire attached to the further end of the lever—which wire runs beneath the deck to the back part of the boat, and is operated by the steersman releasing it, and allowing the tumbler to turn on the pin which screws it to the frame or bed-piece, *a*. The lever can also be operated by the ring attached to its outer end, as shown in the engraving.

Its convenience and saving of labour, its economy in the wear and tear of boats and tow-lines, and its preventing the injury to which horses and drivers are liable, from being drawn into the canal by the tow-line being fouled, render it worthy the examination, as it will commend itself to the approval of all who are interested in navigating our canals.

MISCELLANEOUS.

Cement.—A cement, which gradually becomes very hard, may be made by mixing twenty parts by weight of clean sharp sand, two of litharge, and one of whiting, mixing them with linseed oil to a thin paste. For roofs, it may be mixed with white or red lead, and dry sand thinned with linseed oil.

Important Invention for Preparing Fibrous Plants.—Mon. Jean Blanc, of New Orleans, made a very interesting exhibition of fibres prepared from the stalks of some thirty kinds of wild and cultivated plants. The plants were shown in different stages of manufacture, some of them having parts of the whole plant at one end, and the beautiful flax at the other. Among others were the following plants:—Cotton stalk, wild indigo, asclopias (milk-weed), holly-hock, mallow, marsh-mallow, nettle, wild san foin or lucerne, althea, black mulberry, white mulberry, morus multicaulus, Otaheitan mulberry, yellow willow, manna, okra, passion-flower stalks, Kentucky or ordinary hemp, flax, sugar cane, grape vine, and eight or ten others, including several of the most common weeds, and such as are in many parts of the country considered a nuisance.

The half-prepared specimens showed conclusively that a good and strong fibre can be made from all these plants. How fine these may be made, or how well they may be adapted to fine fabrics is, perhaps, an open question. Some of them, if not all, are undoubtedly fitted to paper manufacture. A piece of rope made from the okra stalk showed to good advantage.

We copy from Letters Patent, dated October 9, 1855, the following description of the process:—

"In my process I cut the plants in August or September, close to the ground, and sink a pit *in the field where the plants grow*, from 6 in. to 2 ft. deep, throwing the earth outside, forming an embankment round the pit. I then commence in the centre of the pit, and set the plants in a perpendicular position, with their buts downwards (*as soon as the plants are cut*, before they have time to die, and while they are still green and alive), and continue to set up around them as near perpendicular as I can, and pressing them closely together until I have filled the pit with the plants or sprouts of the trees, which I cut when young and tender.

"I then commence covering the sides of the same with leaves or straw, so as to surround it perfectly; then I commence throwing the earth against the sides of the leaves or straw, making it several inches thick, until the whole is encased in a wall of earth as high as the tops of the plants, leaving the top of the stack or pile uncovered. The reason for my doing so is, that by excluding the surrounding current of the atmosphere, and the heat of the sun from the plants, I cause the gas contained in the natural state of the plants to be evolved by degrees, or slowly, and as it is carried off at the top of the plants, the moisture of the earth rises up and through the plants, and destroys the glutinous particles thereof, and causes the fibre to separate from the woody substance, preserving its strength and elasticity, and changing the colour to a light yellow. After I have prepared my pit or stack, which may be of any size that the quantity to preserve may indicate, I let it remain in this state from eight to fifteen days, when generally the process will be sufficient; this may be known by taking from the stack at different points and trying it,—if the bark will separate easily from the woody substance, and a light mouldy appearance is visible, then it is time to break up the pit and spread it on the ground to dry.

"When the plant is dry, which will be in from five to ten days, the woody portion is separated by passing the plants through any ordinary rollers or beaters, or by horses treading on them. By this process I get the fibre from the wood, and have all its strength and elasticity preserved, and am now able to manage it without having such great quantities to handle. Several of the fibres of the finest qualities will be perfectly prepared, by this process, for manufacturing. The coarser fibres can be water-rotted for a few days (say six to eight), when they can be fitted for market or manufacturing by the common process of breaking, scutching, and hockling flax or hemp.

"I do not claim burying the plant in dirt, sand, or mud, as described in the 'India process' found in the Agricultural Report of the Patent Office for 1854, page 174: nor do I claim simply setting the plants on the end with the buts down, as described in the 'Southern Cultivator.'"

The following is translated from a German paper:—

"*Sharpening of Edge Tools.*—It has long been known that the simplest method of sharpening a razor is to put it for half an hour in water, to which has been added one-twentieth of its weight of muriatic or sulphuric acid, then lightly wipe it off, and after a few hours set it on a hone; the acid here supplies the place of a whetstone, by corroding the whole surface uniformly, so that nothing further but a smooth polish is necessary. The process never injures good blades, while badly hardened ones are frequently improved by it, although the cause of such improvement remains unexplained. Of late, this process has been applied to many other cutting implements. The workman in the beginning of his noon-spell, or when he leaves off in the evening, moistens the blades of his tools with water, acidified as above, the cost of which is almost nothing. This saves the consumption of time and labour in whetting, which, moreover, speedily wears out the blades. The mode of sharpening here indicated would be found especially advantageous for sickles and scythes.

ROTARY GEARING.

Fig. 1 shows a diagram which will serve to illustrate the principle of this gear, and in which the full drawn circles, *a* and *b*, represent the pitch-lines of two internal wheels hung upon the common axis, *e*, so that each is independent from the other, and the dotted circles, *c* and *d*, the pitch-lines of two external wheels, both fastened together and placed upon the common axis, *f*,—*c* gearing into *a*, and *d* into *b*. Suppose that both the axes, *e* and *f*, be stationary, and the wheels revolving on them as in common wheel gearing, then, according to the well-known mechanical principles of the revolving lever, the proportion of the angular motion of the wheel, *a*, will be to that of *b*, expressed by the following geometrical ratio:—

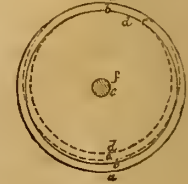


Fig. 1.

$$\text{Angular motion of } a : \text{angular motion of } b :: b, c) : a, d;$$

the letters, *a*, *b*, *c*, *d*, representing the diameters or numbers of teeth of the respective wheels, making, for example, $a = 11$, $b = 10$, $c = 10$, and $d = 9$, then we obtain—

$$\text{Angular motion of } a : \text{angular motion of } b :: 10 \times 10 : 11 \times = 9$$
$$100 \div 99;$$

that is to say, when *a* makes 100 revolutions *b* will make 99, or when *a* makes one revolution *b* will make $\frac{99}{100}$; consequently, after *a* has made one full revolution, *b* will have made $\frac{1}{100}$th part of a revolution less than *a*, and the mutual position of *b* to *a* will have changed as much from its original position; it will, therefore, require 100 revolutions of *a* in order that the wheels may come again to their first position, and the wheel, *b*, will then have made one revolution in relation to *a*.

We will next suppose the axis, *f*, of the wheels, *c*, *d*, to be moving in the centre circle around the fixed axis, *e*, the pitch-lines being constantly in contact with each other; further, the wheel, *a*, to be now stationary, and *b* loose. The *mutual* action of the pitch-lines on each other will now be the same as before, and, consequently, one revolution of the centre, *f*, around *e* will produce the same change in the mutual position of *b* to *a* as before did one revolution of the wheel, *a*; but as *a* is now stationary this change of the mutual position will be the only motion of *b*, while, in the former case, it was the difference between the motion of *a* and *b*, consequently, one revolution of *f* around *e* will produce $\frac{1}{100}$th part of a revolution in *b*, and 100 revolutions of *f* around *e* will give one revolution to *b*.

This may be estimated for any other proportion of the diameters of the wheels, as follows:—Let R denote the number of revolutions of the axis, *f*, around *e*; B, the number of revolutions of the wheel, *b*, on the fixed axis, *e*; *a*, the diameter or number of teeth of the fixed wheel; *b*, the same of the wheel which is revolving on the fixed axis; *c*, the same of the wheel on the revolving axis gearing into *a*; and *d*, the same of the wheel gearing into *b*; then,

$$b, c - a, d : b, c :: B : R.$$

Fig. 2 shows a longitudinal section of an application of our invention. A is a stationary internal bevel-wheel; B is another internal bevel-wheel fastened to shaft, G, which is capable to revolve; C and D are two external bevel-wheels, cast in one piece, C gearing into A and D into B.

The surface of the wheels are drawn to the point, *e'*. F is a shaft to which the double wheel, C, D, is fastened, being supplied on one side with a spherical end that rests into a corresponding socket in the centre of G, at the point, *e'*, where both axes meet. The other end of F bears loosely into the eye of the crank, I, that is fastened to the quick-speed shaft, E.

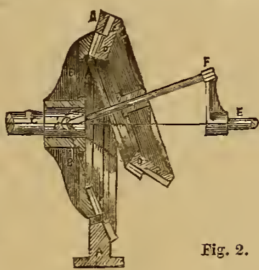


Fig. 2.

CORRESPONDENCE.

THE APPLICATION OF THE WATER SUPPLIED TO HOUSES IN TOWNS FOR WORKING MACHINES AND TOOLS REQUIRING SMALL POWER.

To the Editor of The Artizan.

Sir,—In the publications of the Board of Health it is suggested that water-power might be applied to assist in the operations of small workshops, and there seems no doubt but that it might be advantageously so employed; but there is this objection to it, that water companies could not be expected to furnish gratuitously the requisite supply, and no way of paying for it has hitherto been proposed. It has occurred to me that this might be effected by the formation of a cistern over houses when desired; these cisterns to be filled at the usual time of turning on the water, but at no other period, and the water company might be paid according to the contents of the cisterns. In some instances neighbours might join both in the first cost of the cistern and in the annual rate paid to the water company serving them. There can be no doubt but that this mode of giving motion to machinery would be no less advantageous to mechanics working in a small way than it is in great manufactories, and the cost of raising water by the steam-engine is so trifling that a small rent would suffice to remunerate the water company.

According to the late Sir Samuel Bentham's proposal for Sheerness Dockyard, in 1812, Mr. Mitchell, the Engineer, actually provided hydrons for the water at convenient distances along the range of the water-pipes, whereby the manual labour of three or four scores of men might at times be saved, but this economical expedient has not hitherto been resorted to.

I am, Sir, yours truly, M. S. Bentham.

DOWN DRAUGHTS AND FIRE LIGHTING.

To the Editor of The Artizan.

Sir,—Considerable delay and annoyance is occasioned sometimes in lighting the fires of steamboat boilers, by what is commonly called back-draught, or, in other words, the current of air being *down* the funnel instead of *up*, and if the lighting of the fires be persevered in—especially if the wood used be green or wet—the stokers and everybody else are driven out of the stokehole.

A similar effect is produced from the same cause sometimes in the furnaces of land engine-boilers. In such a case I have had recourse to the soot-door, usually fitted at the bottom of chimney-shafts. The door being removed, a fire is kindled with chips and shavings. The cold air is soon displaced, an ascending current is established, and the smoke is rapidly carried off. The soot-door is then carefully closed.

Now it has occurred to me that a small fire-place might be judiciously contrived and fitted in the smoke-box, or where this would not be convenient, on the steam-chest—so that it was close to, and leading into, the funnel. The fire-place would be permanent, and fitted with a slide or cover to keep out the air immediately the draught is established.

In the hope that *some* plan may be adopted, I have ventured to address you, and ask a space for my communication.

I am, Sir, your obedient servant, Ernest.

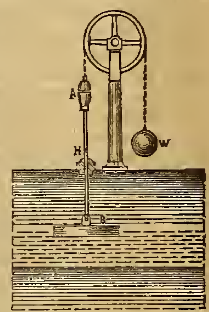
[The plan above described for remedying the inconvenience referred to, although it is not new, deserves attention. We were obliged to be present at the lighting of the fires for a trial or testing of a new furnace and boiler the other day, and suffered the annoyance referred to.—Ed.]

SAFETY APPARATUS FOR STEAM BOILERS.

To the Editor of The Artizan.

Sir,—I beg to submit to your readers a sketch of an alarm-whistle for steam boilers which I have recently contrived, and which is in most successful operation here.

Referring to the diagram, A is a steam whistle, into which is screwed a small brass tube (mine is 3-8th in.). To the other end of the tube is attached the float, B, which rests on the surface of the water in the boiler. The tube slides through the top of the boiler, taking the place of the ordinary rod, which is attached by a chain to the weight, W. There is a hole in the tube at H.



When the water falls the float descends, the weight ascends, and the tube slides into the boiler. When the water is so low that it is dangerous, the hole, H, is so placed as to be within the boiler, the steam enters at it and the whistle sounds.

As water is re-admitted the hole emerges, and the whistle is quiet.

The expense of this apparatus is about twelve or fourteen shillings, and it requires no fitting.

It requires no more stuffing where it enters the boiler than the ordinary float-rod, and with a moderately careful engineer will never stick.

I am, Sir, yours respectfully, Thomas Turnbull.

Whitehall Colliery, Durham, June 1856.

NOTES AND NOVELTIES.

Holyhead Harbour and Breakwaters.—The works now in progress at Holyhead, under the direction of Mr. J. M. Rendel, the engineer, are proceeding with activity, and will comprise a harbour of upwards of 300 acres of deep water, and a roadstead eastward of this, comprising from 300 to 400 acres of deep water, always available for vessels in case of their having to run to the old or the new harbour.

The works involve a north breakwater, 7,000 ft. in length, of which 6,400 ft. have already been formed, in from 7 to 8 fathoms of low water at spring tides; also an eastern breakwater of 2,500 ft., formed in from 3 to 4 fathoms of low water at spring tides, with all the necessary convenience of landing-pier for the largest class of Transatlantic steamers, with railways so laid down on such landing-pier that passengers may step from the boat into the railway carriages.

The quantity of stone used in the works up to the present time, and since 1849, is upwards of 5,000,000 tons. The peculiarity in the construction of the works, which has enabled the Government to carry and place in the breakwater this enormous quantity of stone in less than six years, is the introduction of a timber staging, first built into the sea, slightly in advance of the stonework, upon which there are laid five lines of railway, over which the waggons laden with stone are drawn from the quarry by locomotives, and the stone is deposited into the sea at 20 ft. above high water by the falling of the bottom of the waggons, somewhat in the same way as the "hopper waggons" in the coal districts of the north of England.

The stone is obtained in masses, varying in size from that of ordinary building stone up to 14 or 15 tons in a block.

The average number of labourers and mechanics employed in the quarries and on the railways is from 1,100 to 1,200.

The expenditure up to the present time, including the purchase of land, has been upwards of £500,000, and it is calculated that by the time the works are completed, including the enlargement of the harbour as before referred to, the total cost will amount to upwards of £1,000,000.

New Steamers.—There has been lately launched from the building yard of Messrs. William Simons and Co., a handsome iron screw-steamer, named the *Schiedam*, of the following dimensions:—Length, 160 ft.; breadth, 23 ft. She is intended for the London and Baltic trade, and is the property of an extensive foreign house. There was also lately launched from the building yard of Messrs. James Henderson and Son, Renfrew, a screw-steamer of 350 tons, named *L'Imperatrice Eugenie*, and intended for the Mediterranean trade. She is owned by a company in Corsica. Her engines, of 60 H.P., will be put on board by Messrs. Blackwood and Gordon, of Paisley. A four-masted iron screw-steamer, of 1,400 tons, named the *Rhone*, was lately launched by Messrs. Smith and Rodger, of Glasgow, for Messrs. John Bibly, Sons and Co., of Liverpool. The engines, 180 H.P., are to be put on board by Messrs. Macnab and Clark, Shaws Water Foundry. She is intended for the Mediterranean trade. The magnificent paddle-steamer *Valparaiso*, of 1,400 tons, built by Messrs. John Reid and Co., Port-Glasgow, has been fitted up by Messrs. Randolph, Elder and Co., with engines of 320 H.P., having their patent double cylinder, and her paddles are on the feathering principle. She has accommodation for 300 passengers. She is brig rigged, and will carry a press of canvas. This vessel is the property of the Pacific Steam Navigation Company. On Monday, June 9, Messrs. Robert Steele and Co. launched a handsome clipper brig, named *Hebe*, of the following dimensions:—Length, 96½ ft.; breadth, 19¾ ft.; depth, 11 ft.; register tonnage, 126 27-100. She is the property of Messrs. Baine and Johnston, and is intended for the Newfoundland trade.

Boiler Explosion.—A boiler exploded at the colliery works of Messrs. Wharton, on Monday, June 9, at Whittington Hall, about two miles to the north of Chesterfield, Derbyshire. One man was killed upon the spot, and another seriously injured. The effect of the explosion was felt for nearly four miles around the spot, and many buildings were shaken. The engine-house, boiler, and engine apparatus, pit gear, &c., were raised in one blackened mass several hundred feet into the air, intermingled with a volume of steam which clouded the atmosphere for some minutes. The colliers had commenced their labours as usual, and the engine-tenter, George Holmes, an old man, was engaged in attending to his duties at the time the explosion happened. A collier named Cook, a single man, residing on Whittington Common, was in the act of lighting his pipe at the fire-grate, when, in a moment, the boiler was raised from its bed, and the whole mass of brickwork was sent in all directions. Cook's body was carried along with the fragments, and fell at a distance of 20 yards from the spot, mutilated and lifeless. His clothes were torn to tatters. Holmes, the engineman, was carried by the force of the explosion a distance of 15 yards, and fell against a hedge bank, where he was picked up in a state of insensibility. On recovering he said he could not account for the accident. He was removed to the hospital at Chesterfield. That the explosion was owing to a deficiency of water in the boiler there is every reason to believe, as Holmes was in the act of replenishing the boiler when it took place. The boiler, weighing upwards of 5 cwt., was carried about 350 yards in a north-easterly direction, and fell in a clover field near the Midland Railway, while the boiler end was borne easterly, and deposited in a grass field, at nearly the same distance. Another portion, containing the safety-valve and the feed-box, weighing upwards of 3 cwt., was carried, in a northerly direction, about 400 yards.

The Hobbs Lock Picked.—The "Illion Independent" asserts that the Day Newell Lock, manufactured at New York, commonly known as the "Hobbs Lock," has at last been picked by Linus Yale, Jun., of the adjoining village of Newport. It says:—"The exact *modus operandi* of picking the lock, of course, is not expected to be made known to the public just at present; but it is sufficient to say that, by a singular and ingenious method, the action of the key upon the curve of the tumblers of the lock is mapped out, and from this a wooden key is made, which unlocks and locks the lock, and in all respects operates on it as perfectly as the true key. In this respect the lock was opened in the presence of the cashier of the Dairyman's Bank, Newport, N.Y., and of the president of the Port Stanwick Bank, Rome, N.Y. And within a few weeks was so opened a 300 dollar lock on a jeweller's safe, in Wall Street, N.Y.; from all of whom certificates to this effect have been taken. This statement of course will astound the world, but it is even true."—*Wolverhampton Chronicle.*

Interesting Experiment in Steam Navigation.—A trial trip of a steam-vessel took place in the Thames, on Saturday, the 7th ult. The *Hoyer*, a paddle-steamer of nearly 190 tons, and drawing only 2 ft. of water, has been constructed to navigate the shallow waters on the west coast of Denmark, between the islands and the main land. The following are her dimensions:—Length, 120 ft.; breadth, 18½ ft.; depth, 7½ ft.; gross tonnage, 190; H.P., 40; with accommodation for eighty passengers and 100 tons of cargo. On her trial-trip, with the wind against her, and with so little hold of the water, she averaged twelve miles an hour, with scarcely any perceptible effort or vibration, and fully realised the expectations of her constructors. She has been built for the Husum and Hoyer Steam Packet Company, composed of Danish and English proprietors, to ply between those places and the islands, in connexion with the Royal Danish Railway, which connects the North Sea with the Baltic.

Chemistry of Cast Iron.—In 1849 a chemical laboratory was established at the United States Arsenal at Pikesville, Md., for the purpose of analysing the cast iron employed in the manufacture of guns, and the charge of the experiments was committed to Campbell Morfit, Esq., as analytic chemist, with Professor Booth, of Philadelphia, as consulting chemist. The experiments extended over a considerable period of time, the final report of them being made last year. A great number of them were instituted, the reports of which are very minute, and exhibit a profound knowledge of chemical analysis. They are valuable to iron manufacturers and engineers, in relation to two kinds of cast iron—that produced by the cold and that by the hot blast. The average specific gravity of the cold blast iron was 7·218, and the tensile strength was 29·219. The specific gravity of the hot blast iron was 7·065; the tensile strength 19·640. The extraneous substances combined with the iron were found to be allotropic carbon, combined carbon, silicium, slag, &c. It would appear that the iron having the greatest amount of combined carbon with the least slag was the best, and was found to be made by the cold blast. The hot blast appears to drive off some of the combining carbon, at the same time leaving a greater quantity of allotropic carbon, existing in a form analogous to graphite, or black lead, which is injurious. The report says:—"The slag and allotropic carbon, being of a brittle nature, and not united with the iron, coat the crystalline plates of metal, and diminish their surface of contact; consequently, it follows that the tensile strength of the metal must decrease in proportion to the increase of slag and allotropic (uncombined) carbon." From the analysis the lesson is derived, that hot blast is inferior in strength to cold blast iron, and the reason of this is owing to the greater amount of slag and uncombined carbon in the former. Great advances have yet to be made in the manufacture of cast iron to improve its quality and reduce its cost. It requires two tons of coal to make a ton of pig iron; we can easily conceive the benefit that would accrue to all if some inventor were to discover a process to manufacture with half this quantity of coal. We hope such an improvement will yet be made. Recently, a kind of pig iron (the *Thomas*, of New Jersey), has been brought into the market, which, for the most of purposes, will supersede the Scotch pig iron, and it sells for 3 dols. less per ton. It is very soft, and flows smoothly, and is, therefore, well adapted to mix with our general hard and strong American cast irons. Its soft quality is due to the ore from which it is made, not from any new improvement, we understand, in its manufacture. The great variety of iron ores in our country, and the vast extent and easy working of our coal beds, demand from our iron manufacturers much better and cheaper cast iron than has been produced. We ought to make—and yet shall make, we believe—the cheapest iron in the world. Who can describe the benefits that would be conferred on our people if iron were sold for one-half its present price. It would tend to reduce the cost of machinery, and give an impetus to every branch of business in our country—agriculture, architecture, commerce, &c. We hope and trust that our iron manufacturers will heed these suggestions, both for their own sakes and that of the public.—*Scientific American.*

The Royal Society and the Government.—At a special meeting of the Royal Society, held on the 3rd ult., the following resolution was passed, on the motion of Sir Benjamin Brodie, seconded by Professor Bell:—"That the Council be authorised to accept and carry out the proposal of the Government, as to the occupation of Burlington House, on the understanding that the hall, which it is proposed to construct in the west wing, and which is to contain the portraits belonging to the Royal Society, shall be placed in the custody of the Royal Society, subject to the free use of it by the senate of the University of London at all times at which it may be required for their examinations and public meetings." The library of the Royal Society now comprises 45,000 volumes. The Linnean Society and the Chemical Society will also have accommodation given to them in Burlington House.

Launch of a New Screw-Steamer.—Another screw-steamer was launched on Wednesday, the 11th ult., from Messrs. Samuelson's shipbuilding yard, Wincolmlee. The vessel was launched sideways. She is named the *Lucien*, and her dimensions are:—Length, 174 ft.; beam, 28 ft.; depth, 16 ft.; burthen, 850 tons. Owners: Anglo-French Steam Ship Company (limited).—Another screw-steamer will be launched in the same manner from Messrs. Samuelson and Co.'s yard in the course of the month.

The Largest Steamer in the World will shortly arrive at Southampton, from New York. She is 5,000 tons burden, and is named the *Vanderbilt*, and until the mammoth steamer, now building for the Eastern Steam Navigation Company, is launched, the *Vanderbilt* will be the largest steamer afloat. The tonnage of the *Himalaya* is only 3,500 tons. The *Vanderbilt* is not much longer than the *Himalaya*, but her width is enormous, being upwards of 60 ft.

The Smoke Nuisance.—A bill, brought down from the Lords on the 26th ult., repeals the provision in the 16th and 17th of Victoria, c. 128, which exempts glass and pottery works from the operation of the Act; but the repeal will not take effect until the 1st of January, 1858.

Preventing the Escape of Acid Vapours: by MM. Ch. and Al. Tissier.—The process which we apply in this case consists in interposing, between the principal flue and the tall chimney of the manufactory, a species of lime oven, heated by a contiguous furnace, and into which will enter, on the one side, in consequence of the draught, all the vapours from the factory, on the other, the flame of the furnace intended to heat the lime with which the oven is filled, a certain temperature being necessary for the complete absorption of the acid gases. It will be clear that the arrangement of the oven may be varied *ad infinitum;* consequently our process consists essentially in the use of lime, or carbonate of lime, brought to such a temperature that the absorption shall be as complete as possible, the elevation of the temperature aiding at once the draught of the chimney and the absorption of the acid gases.

This process is used at our manufactory at Amfreville, near Rouen, where aluminium is at the present time extracted on a very large scale, and it has given excellent results in stopping the acid vapours produced by the maufacture of chloride of aluminium. It is well known that these vapours, composed of chloride of silicium, chloride of aluminium, chloride of sulphur, aud hydrochloric acid, are extremely sharp and corrosive, and it is to the interest of all to prevent their escape.—*Comptes Rendus.*

Steam-Tugs on the Nile.—About two years ago the Viceroy ceded certain privileges to a company to be formed in Egypt for facilitating the transport of produce from the interior to Alexandria, and of imports from Europe to the interior of Egypt, by means of steam-tugs on the Nile and canal under the Egyptian flag. This company has since been in abeyance, from the circumstance of the projectors having presumed on the privilege granted to them collectively, by asking too much from the public to make them partakers in its advantages; and, after the allotment of £30,000 in shares of the company to the original projectors, it has just been re-organised by practical parties on a more liberal footing towards the public, and has received the Viceroy's sanctiou and adherence by an official firman, his Highness himself taking a considerable amount of shares. The present capital is to be £200,000 sterling, in shares of £20 each. The Mahmoudieh canal has just been deepened, and, among other duties devolving upon the new company, will be the keeping up of a sufficient supply of water for navigation and the irrigation of the adjacent lands by a means of steam-pumps, to be placed at its junction with the Nile. The company has further in view to open the canal to the sea by a lock for the passage of lighters, so as to expedite the loading of ships.

Working of African Native Iron.—At a recent meeting of the Natural History Society of Boston, Dr. A. A. Hayes exhibited specimens of native iron from Liberia, and gave the historical and chemical evidence of its having been in use many years by the natives. By the simple process of hammering, this iron has been converted into rude instruments. It contains $1\frac{1}{2}$ per cent. of crystals of quartz and magnetic oxide of iron, and, consequently, has never been heated or wrought. There is no trace of carbon, or manganese, or nickel, which, by their presence, would show it to be meteoric. This subject is interesting to the archæologist, as well as the mineralogist, as furnishing another example of the working of metal, like the cold wrought copper of the ancient miners of Lake Superior—without smelting, or other than mechauical means.—*Canadian Journal.*

Internal Improvement in Egypt.—Of the capital stock of the Suez canal, forty-five millions of francs worth was reserved to be subscribed in Egypt, and of that the viceroy took fifteen millions. The remainder was entirely subscribed in three days by the public, and one million nine hundred thousand of the amount was taken by fifty native Egyptians of the ancient race—being the first known instance of the participation of that people in an industrial enterprise of a national or corporate character. A new light is certainly breaking in upon ancient Egypt, the mother of the arts. Who knows but it may yet arise to more than its ancient greatness?—*Scientific American.*

Experiments with Cast Iron.—The interesting fact is developed by experiments of the U.S. Ordnance Department, that iron, by repeated fusion, up to a certain number of times, is thereby greatly improved in strength. Guns cast solidly, and those cast hollow, through which latter water was made to circulate after casting, showed an astonishing difference in their relative strength, the difference being in favour of the hollow cast gun, which is attributed to the method of cooling, the solid gun, contracting from the outside, exerting a strain upon the arrangement of the particles of the metal in the same direction as the strain of the discharges. The experiments also showed that old castings are a great deal stronger than new: 8-in. guns, proved thirty days after being cast solid, stood about seventy-two charges; thirty-four days, eighty-four charges; a hundred days, 731 charges; and six years, 2,582 charges. This phenomenon is accounted for by supposing that the particles strained in the cooling re-adjust themselves in the course of time to their new position, and become free, or nearly so.—*New York Paper.*

Iron Ship-Building.—Launch of the New Screw-Steamer Neva.—A magnificent screw-steamer was lately launched from Messrs. Charles and William Earle's iron ship-building yard on the Victoria Dock side. She measures 200 ft. in length, 25 ft. beam, and 15 ft. deep, and is about 600 tons burthen. She is intended to be a St. Petersburg trader, and is the property of Messrs. Thomas Wilson, Sons, and Co. She is of about 150 H.P., and has two 40-in. cylinders of great strength, calculated to bear a pressure of 30 lbs. to the sq. in. She is built on quite a new principle, after the American Atlantic steamers. She has diagonal straps, is double rivetted throughout, and from the ceiling upward she is fastened with Cope iron, 18 in. apart. She has no bowsprit, but is built with 15 ft. relief, with a Russian eagle at her head. Her stern-frame and rudder are on Beattie's principle. Her screw measures 12 ft. across, with 24 ft. pitch. She has a full poop and extra passenger accommodation, and her cabins will be fitted up with polished mahogany and polished maple. Her bulwarks, which are 5 ft. high, are also made of iron. She will have tubular boilers, of extraordinary strength, and engines of corresponding power. She is classed A 1 at Lloyd's for twelve years, aud, from her beautiful proportions, is well calculated to prove, in every way, highly successful.—A second screw-steamer, for Messrs. W. and C. L. Ringrose, will be ready for launching in a few weeks; she is intended for the Rotterdam and Antwerp trade, and will be constructed so as to carry a large cargo with a light draught of water.—A third boat, also, is already in the frame, which is intended to work on the high-pressure priuciple, like a locomotive boiler. She will be about 400 tons burtheu, and will be the property of Messrs. Thomas Wilsou, Sons, and Co., and is the first one of the sort ever built in Hull.

Fall of a Suspension-Bridge in Canada.—Intelligence reached Quebec on the 30th of April that the suspension-bridge over the Montmorenci had given way, and that several lives had been lost. There had been statements made before to the effect that the bridge was not to be trusted. People crossed it with terror, it was so shadowy, so light, and so high. Like a mere cobweb, it hung across the chasm over the very brink of the Falls. The superintending engineer had asserted that the structure was safe, and the road trust had taken possession of it. Nevertheless, ou the northern bauk of the Montmorenci, five of the seven strands of one of the wire cables had previously given way, and the cable had been repaired. On the 30th of April, while a man and a woman were crossing in a cart, and a lad, sixteen years of age, was crossing on foot, the chain-plates attached to the anchors on the south side of the Montmorenci snapped asunder, and the bridge dropped down, throwing all upon it over and down the Falls into the pool, 300 ft. below. The bridge is a complete loss to the turnpike trust, Nothing stands except the towers, one only of which is injured. The bridge cost £9,000. —*Quebec Gazette.*

Trials with a New Mortar.—Important experimeuts have been made during the past month with a 13-in. mortar, near Portsmouth. The object of the trial was to test the utility of a peculiar contrivance for the purpose of preventing the mortar becoming heated and damaged by any lengthened firing, as was the case at Sweaborg. At one day's trial 300 shells were discharged, the time occupied being nine hours, giving two minutes only as the average of each round. On another trial 150 shells were fired in equally rapid time. At the conclusion of these trials the mortar subjected to this severe test seems to have received no material injury from the fusion or cracking of the metal; the contrivance is, therefore, so far, highly successful in its action.

Artesian Well at Passy.—The boring for this well has now reached a depth of nearly 400 met., and it is hoped that water will soon be arrived at. The artesian well at Grenelle, which was seven years in boring, is 540 met. deep.

Russia—Public Works.—The Emperor of Russia has expressed the hope, in the presence of General Tschewkine (the Minister of Public Works), that the indispensable means of furthering the internal development of Russia, viz., iucreased means of communication, would form the subject of the special care of the Imperial Government. For the purpose of furthering the construction of canals, railroads, highroads, and steam navigation, Von Borch, the Minister of Finance, is empowered to treat with foreign capitalists. Also, that the High Admiral of the Fleet, considering that a supply of fuel is a vital question for the steam fleet, has appealed to the Imperial Mining Establishments to devote their attention to the discovery of any—even the smallest—strata of coal, and has invited private persons to join in the search.

Egypt—Public Works.—After having made a portion of the embankment for the line of railway between Alexandria and Mareotis, Said Pacha has abandoned the idea of completing the work. The deepening of the Mahmoudieh canal was commenced on the 8th ult., where 100,000 labourers are employed, and it is expected it will be very shortly completed, when the canal will again be navigable and the trade of Alexandria will resume its wonted activity. The Pacha has deepened the important canal of Damanour, which feeds the Mahmoudieh canal at low Nile, and has ordered to be made several good roads in the interior connecting the principal towns, which will eventually be very beneficial to the country. A lighthouse is ordered by his Highness to be erected at Suez, the lantern to be brought out from England, which will be of great advantage to steamers arriving at Suez by night.

New Hydraulic Machinery at Woolwich.—Messrs. W. G. Armstrong and Co., of Newcastle, having erected some new cranes on the platform of the new pier, in the Arsenal at Woolwich, which were tried a few days since, under the superintendence of Mr. Anderson, C.E., the Inspector of Machinery, worked most satisfactory. The whole of the apparatus is controlled by one man, who, by means of the valve-lever, is able to raise, lower, or slue, with great rapidity enormous weights. These cranes are worked by the pressure of water confined in a cylinder, into which it is forced by means of a 30 H.P. steam-engine. Through this cylinder the water pressure is distributed in all directions. It is also used to work an apparatus for heaving the cargoes out of coal vessels. It is also to be used for forcing water up to an immense reservoir, situated on Shooter's Hill, to be used for extinguishing fire, and other purposes. There are twelve cranes to be connected with the cylinder or the accumulator, so that the power of the War Department to ship and unship stores will be enormous.

The Canadian Railways.—One end of the line of the Grand Trunk Railway of Canada terminates at Portland, an important seaport town upon the east coast of America, about 300 miles from New York, and from thence the railway proceeds to Montreal, with a fork to Quebec. The railway then proceeds westward, and joins the Great Western of Canada Railway at Toronto, so that there will be one continuous route from the east coast of America at Quebec, over the St. Lawrence, and Portland, in the United States to Montreal, and thence to the extreme west of Canada. The whole of this line will shortly be completed. The entire cost, including the Victoria Bridge, will average £10,000 per mile.

Tees Conservancy—Progress of Works.—It is reported by Mr. Fowler, the engineer, that the weather below Cargo Fleet, during the past month, has been somewhat unfavourable to the progress of the work. The dredger has only been able to be worked nineteen tides in the four weeks; the quantity dredged during that time was 4,580 tons, which has been deposited in the line of the embankment. The total length now in progress is 1,600 ft. The improvement, during the past month, in the channel has been very satisfactory. The shoal that was so much complained of last winter is now gone, there being a depth over it of 5 ft. at low water of spring tides.

Removal of the Iron Gate in the Upper Danube.—The Engineers that were sent out a year ago to blast the sunken rocks at the Iron Gate have received orders to return, their efforts not having been attended with success. The rocks are the best allies of the Danubian Steam Navigation Company, as they formed a barrier between the Austrians and any foreign speculators that might take advantage of what they consider their indisputable right to navigate the Upper Danube.

Submarine Telegraph Across the Humber.—Across the bed of the Humber, near New Holland, has recently been laid, by the Electric Telegraph Company, two miles of electric telegraph cable, weighing about four tons, with a view to providing a direct line of communication between Hull and London, *viâ* Grimsby and Peterborough. The sinking of the cable was successfully performed under the superintendence of the Company's Engineer, Mr. F. C. Webb.

Mediterranean and Jerusalem Railway.—A line of railway has been projected from the Mediterranean Sea to Jerusalem. One part of the arrangement, with which the English Government has sympathised, provides that the Balaklava railway should be transferred as material for the proposed line.

New Screw Collier.—The Messrs. J. and G. Thomson, of Govan, lately launched, at their ship yard, an iron screw steamer—the *Stirling*—intended for the South Wales coal trade. She measures about 800 tons, and her engines are of 100 H.P. She was built under the superintendence of Mr. J. G. Laurie, of Glasgow, and is fitted with patent water ballast tanks, steam cranes, &c.

Docks at Trieste.—The Austrian Government have been asked permission, by an English company, to construct docks at Trieste; but before his Majesty gives his consent he desires to see the plans, &c. Mr. Tuson, the Company's representative, is now at Trieste.

NOTICES TO CORRESPONDENTS.

S., *Hayle Foundry*.—The apparatus described, and of which you have sent us drawings, &c., differs in three material respects from the patented contrivance you refer to, as having been recently brought prominently before the public. Fusible metal plugs have long been used, but when exposed to the action of the fire the outer surface very quickly becomes oxidised, and the inner surface becomes coated over with scale; thus the fusible plug becomes useless. The position of your float-lever is bad, the working joints, pins, &c., *within* the boiler, are objectionable. The apparatus for preventing the safety-valve from sticking in its seat would, without doubt, effect its object, but a valve-seat and valve respectively constructed of suitable metal, and properly bevelled and ground in, should never stick or set fast. There is, however, considerable ingenuity exhibited in some of the plans, and we may hereafter refer to them.

P. O.—The book you refer to was duly received, and will be noticed in turn. We have considerable arrears of reviews and notices of books to clear off, and which we hope to do in our next and the following number.

J. J. (*San Francisco*).—Yes; Messrs. Penn and Son, of Greenwich, and Messrs. Rennie and Sons, Blackfriars. We *have* given the dimensions of the gun-boats. Look through last year's numbers.

P. Howson.—Yes; Messrs. Hodges and Smith, Dublin.

An Apprentice.—1st. There are several. 2nd. Forty-four square in. 3rd. 63 lbs. on each sq. in. of surface. 4th. A T section. 5th. Cottam and Hallen, Lambeth. We cannot devote sufficient space to answer the other queries.

T. Taylor.—1st. The area of fire-grate, say 6 2-3rds sq. ft. 2nd. The total heating-surface in the tubes, say 139 sq. ft. 3rd. Working pressure in boiler, 50 lbs. 4th. There is no general rule for proportioning the area of safety-valve to the power of engine. Boilers having large fire-grate and heating surfaces, generating steam quickly, require a valve of larger area than boilers wherein the steam is generated slowly. 5th. Two safety-valves should be used, each of a size sufficiently large to permit the steam to blow off as quickly as it can be generated at the maximum pressure to which the valve can be loaded 6th. Bourne gives it in the new edition of his "Catechism of the Steam-Engine." —*See.* p. 201. 7th. We can recommend the annular safety-valve patented by Mr. William Hawthorn, of Newcastle, having tested it severely.

J. Liddle.—We are now enabled to reply to your queries, received too late to permit of our doing so in our last, as notified to you in "Notices to Correspondents." 1st. A cast-iron pipe, 4 in. in the bore, will deliver the required quantity. 2nd. We have not been able to decipher two figures in the second question. 3rd. Wrought-iron tubes, $1\frac{1}{4}$ in. bore, must be used; the joints, being screwed together, will ensure their being strong enough to resist the shock; and if the ends of the tubes *butt*, no interruption will be offered to the passage of the fluid. John Russell and Co., of Thames Street, supply the article as good and at as low a price as it is possible to obtain it. 4th. By reference to "Downing's Elements of Practical Hydraulics," pp. 80 and 81, and pp. 121 and 122, you will find what you inquire for. 5th. You will find the subject treated of in "Ewbank's Hydraulics," twelfth edition. (New York).

A. P. R.—The machine for semi-dividing the postage-stamps consists of a set of punches sufficient to puncture three sides of each postage-stamp in one row at a time, mounted in a beam, the width of the sheets to be perforated; this beam slides in parallel groves in the side-frames of the machine, and is worked by an eccentric. Several sheets of stamps are placed accurately, by means of guide or register-pins, in a travelling-frame or tympan, which is caused to move forward the distance of one row of stamps each time the beam containing the punches rises, the frame being moved by a rack one tooth at a time, that great accuracy is insured. The punches descend when the table or frame is at rest, and thus each of the twelve stamps forming the width of the sheet being semi-divided, the twenty rows of stamps forming the length of the sheet are similarly treated by twenty-one rows of perforations made by twenty-one strokes of the beam. This is the description of the machine in use at Somerset House, and known to the public as Archer's Patent; but we happen to know that Mr. Archer was totally ignorant of practical mechanics in general, and of the present form and construction of the machine claimed as his invention, at the time he patented it; and that but for the practical assistance of Mr. E. Hill, of the Stamp Office, who, we understand, gave the present shape and perfect arrangement of parts to the machines, it would not have been adopted by the Government. Therefore, £4,000, the price paid by the Government for the patent, was a fair, if not a liberal sum. Bemrose and Sons, of Derby, exhibit at the Crystal Palace a machine for perforating cheques, labels, &c., which works well.

C. Hewett.—*See* chapter vii. of J. Murray's "Treatise on the Stability of Retaining Walls," published by Weale.

We have received the following letter from Mr. G. W. Jaffrey, of Hartlepool, with reference to the three cylinder engines described and illustrated in our May number. We shall take an early opportunity of examining the engines and boilers alluded to, and may refer to them hereafter:—

Sir,—I beg to send you, enclosed, a drawing of inverted trunk engines I designed, while manager to Messrs. Scott, Sinclair, and Co. Since I left and came here they have started three pair, which I left finished in the shop, with, I believe, the very best results. I enclose a diagram, taken from second pair.*

The three cylinder engines I send you, from observing a drawing of the American engines in the May number of The Artizan. I designed these engines, in 1844, for the Turkish Government. They were submitted to our government, but Messrs. Napier got the contract. I was the first to apply three cylinders to direct-action screw-engines, and have made and fitted three pairs, the last being the screw transport *Oneida*, of 450 H.P.; if you wish I will send you a tracing of those engines. I am also making a set of three cylinder engines for a ship we are building for W. S. Lindsay, Esq., and for which we have obtained a patent. They are inverted trunks, similar to tracing enclosed, but occupying no more room fore and aft than two cylinders same power.

The boiler I designed some time ago, but never put it into practice. I do not know whether such a plan has ever been applied. I think vertical tubes are every way preferable to the common plan for generating steam.

I am, yours truly, George W. Jaffrey.

Hartlepool Iron Works, Hartlepool.

* The diagram referred to is excellent.—Ed.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 23rd January, 1856.

461. J. Gedge, 4, Wellington-st., South, Strand—Preparing and combining metallic substances for producing colours, and in manufacturing the same.
462. J. E. Boyd, Hither-green, Lewisham—Scythes.

Dated 6th March, 1856.

564. T. Tisdall, Reynoldstown-house, Dublin—Machinery for propelling steam vessels.

Dated 4th April, 1856.

820. J. G. Martien, Newark, New Jersey, U.S.—Manufacture of iron.

Dated 7th April, 1856.

836. J. Gedge, 4, Wellington-st. South, Strand—Tiles.

Dated 24th April, 1856.

980. A. S. Stocker, 11, Poultry, Cheapside—Application of certain materials to the manufacture of ink and other stands, and other articles, and in the manufacture and finishing of articles produced out of such or other material or materials.

Dated 25th April, 1856.

992. G. E. and W. W. Pattinson, Newcastle-on-Tyne—Production of peroxide of manganese.

Dated 6th May, 1856.

1062. O. Blake, Thames Plate Glass Works, Blackwall—Applying practically the principle of internal reflection within transparent substances.
1064. W. J. Curtis, 1, Sebbon-st., Islington—Constructing the permanent ways of railways.
1066. W. E. Newton, 66, Chancery-la. — Machinery for making envelopes.
1068. R. A. Brooman, 166, Fleet-st.—A method of treating guano and other matters containing uric acid and the manufacture from the products arising from such treatment as well as from uric acid, of new colouring matters, and the fixing and application thereof.

Dated 7th May, 1856.

1069. J. Furnevall, Haslingden—The construction of valves.
1070. G. Martin, 6, Windmill-ter., Camberwell, and A. L. Newman, New Church st., Bermondsey—Freeing or purifying animal fibres from admixture with vegetable matters.
1071. W. J. Curtis, 1 Sebbon-st., Islington—Carriages to run on rail or tramways and common roads.
1072. R. Heaton, jun., H. Heaton, and G. Heaton, Birmingham — Manufacture of balance weights used for counterbalancing pendant lamps and chandeliers, and for other like purposes.
1073. S. A. Bell, and J. Black, Bow-la.—Preparation for igniting matches.
1074. J. Périnand, Paris—Preparing or dressing silks.
1075. R. Royds, Southampton—The manufacture of soap.

Dated 8th May, 1856.

1076. L. G. Perreaux, 16, Rue M. le Prince, Paris—Valve.
1077. C. Schneider and F. Leiss, Hesse Darmstadt—Safety boiling apparatus.
1078. L. F. Mayer, 133, Regent-st.—Photography.
1079. A. E. Riddle, 33, Walbrook, and I. H. Boyd, 3½, Mansion-house-pl.—Tanning by machinery and chemicals.
1080. J. Niven, Keir, N.B.—The manufacture of paper, and in the production of textile materials.
1081. J. G. Lawrie, Glasgow—Steam-engines.
1082. J. Amory, Boston, U.S.—Furnaces for locomotive and other steam-boilers, which improvements are applicable to reverberatory and puddling furnaces, and to furnaces for heating buildings.
1083. C. W. Finzel, Bristol, W. Needham, Smallbury-green, Middlesex, and J. Barton, Shoe-la.—Apparatus for filtering sugar and saccharine juices.
1084. R. A. Brooman, 166, Fleet-st.—Machinery for felting or sizing hat bodies.
1085 A. Alliott, Park, Nottingham—Drying apparatus.
1086. W. E. Newton, 66, Chancery-la. — Machinery for cutting, punching, and forging, or swaging nuts or washers.
1087. A. C. L. Devaux, King William-st.—The construction of granaries.
1088. A. V. Newton, 66, Chancery-la.—Rotary pump.
1089. A. V. Newton, 66, Chancery-la.—Bands for securing bales of goods, and for other like uses.
1090. S. W. Underhill, Wellfield-cottage, Dunse, Berwickshire—Preservation of life in cases of shipwreck or other casualty at sea, the Buoyant Cushion.

Dated 9th May, 1856.

1091. L. L. Jardin and J. Blamond, 39, Rue de l'Echiquier, Paris—Engraving on stone, earthenware, china, and glass, and also in ornamenting the same.
1092. W. Bayliss, Wolverhampton — Chains for collieries, cables, and other purposes.
1093. J. H. Johnson, 47, Lincoln's-inn-fields — Carding engines for carding cotton and other fibrous materials.
1094. J. W. Hackworth, Priestgate Engine Works, Darlington — Machinery for raising and lowering heavy bodies.
1095. F. Potts and T. Vann, Birmingham—Machinery for ornamenting, floating, burnishing, and polishing metallic tubes, part of which machinery is also applicable for performing the like operation upon other metallic surfaces.
1096. E. D. Johnson, Wilmington-sq.—Mode of mounting marine chronometers.
1097. G. J. Firman, Newton-le-Willows, Lancashire—Manufacture of sulphuric, tartaric, citric, and oxalic acids, ammonia, and cyanides.
1098. W. E. Wiley, 34, Great Hampton-st., Birmingham—Manufacture of pens and penholders.
1099. W. Basford, 16, Talbot-rd., Kentish-town—Apparatus for purifying coal gas.
1100. L. Beauché, Offenbach, Frankfort-on-the-Maine—Machine for the manufacture of cigars.
1101. G. Simpson, Leather-la.—Rotary knife-cleaning machines.
1102. R. A. Brooman, 166, Fleet-st.—Cranes.
1103. R. A. Brooman, 166, Fleet-st. — Machinery for the manufacture or finishing of tyres, hoops, and rings.
1104. F. R. Laurence, Southampton-st. — Manufacture of shirt collars and wristbands.

Dated 10th May, 1856.

1105. R. A. Brooman, 166, Fleet-st.—Machinery for manufacturing tubes and pipes, applicable also to the rolling of rods and bars.
1106. J. Binns, Dukinfield—Machinery for winding, sizing, and beaming yarns.
1107. J. H. Johnson, 47, Lincoln's-inn-fields—Machinery for cutting irregular forms.
1108. J. Wallace, jun., Glasgow — Preparing, bleaching, washing, cleansing, and drying textile fabrics and materials and pulpy substances.
1109. R. Wotherspon, Glasgow—Hats and other coverings for the head.
1110. J. H. Johnson, 47, Lincoln's-inn-fields—Drying leather and dressed skins.
1111. J. Ridal, Sheffield—Spring knife handles.
1112. W. Burkin, Neate-st., Old Kent-rd.—Machinery for manufacturing painted cloths.
1113. B. Beniowski, Bow-st., Covent-garden—Typographical composition, and in the manufacture of logotypes to be used therein.

Dated 12th May, 1856.

1114. C. F. Claus, Latchford, Chester—Moistening land, streets, and the better extinction of fires.
1115. P. E. Aimont—Manufacturing shoes and other coverings for the foot.
1116. R. Whytock, Edinburgh—Apparatus to facilitate the printing of yarns or threads.
1117. E. B. de la Pontonerie, Paris—Apparatus for consuming smoke.
1118. B. Samuel, Sheffield—Manufacture of combs.
1119. W. E. Newton, 66, Chancery-la. — Machinery for pumping and forcing water and other fluids.
1120. W. E. Newton, 66, Chancery-la.—Machinery for splitting or cutting blocks of wood, for match splints, kindling wood, trenails, and other purposes.

Dated 13th May, 1856.

1121. C. B. Clough, Llwyn Offa—Elongating and contracting metal bars or rods for the obtainment of motive-power.
1122. M. Hodge, Simpson, Massachusetts, U.S.—Machinery for combing wool or other fibrous substances.
1124. H. Tucker, Massachusetts, U.S.—Spring sacking or foundation for a bed mattress, or other like article.
1125. A. Parkes, Birmingham—Preparing materials for and in waterproofing and coating woven and other fabrics, paper, leather, and other substances.
1126. C. Boosey, 24, Holles-st., Cavendish-sq.—Music stands for the use of military and other bands.
1127. R. Raywood, Penistone—Railways.
1128. W. E. Newton, 66, Chancery-la.—Apparatus for generating illuminating gases from coal or other substances.
1129. W. E. Newton, 66, Chancery-la.—Machinery for removing snow from railroad tracks.
1130. W. E. Newton, 66, Chancery-la.—The novel application of certain substances to be employed in printing upon woven or other fabrics, and paper.

Dated 14th May, 1856.

1131. H. Bragg, jun., Belfast—Machinery for finishing linen and other fabrics.
1132. W. Galloway and J. Galloway, Manchester—Machinery for rasping, cutting, and chipping dye woods.
1133. H. Groves, New York—Tune barrels or cylinders, or other apparatus for playing upon organs or other musical instruments.
1134. J. H. Riddell, 5, Sherborne-la., City—Stoves, &c.
1136. J. A. Drieu, Patricroft, near Manchester—Weaving horse cloths, blankets, rugs, or similar thick materials.
1137. A. Tolhausen, 7, Duke-st., Adelphi—Distance indicator for public carriages.
1138. U. Scott, Camden-tn.—Public carriages, and various parts of the same, which parts may be used separately, and applied to vehicles of any description.
1139. G. P. Harding, Kingsland—The manufacture of cloth bonnets.
1141. C. Olivier, 37, Finsbury-sq.—Mode of preparing and applying silk waste.
1142. C. Gibson, Draycott, Derby—Machinery for the manufacture of bricks, tiles, and other articles made of clay or plastic materials.
1143. W. Crofts, Derby-terrace, Nottingham-park—Manufacture of lace and other weavings.
1144. W. H. Harfield, 113, Fenchurch-st.—Machinery for cutting and smoothing the surfaces of metallic nuts.

Dated 15th May, 1856.

1146. J. Cox, Ivy-bridge cottage, Caerleon, Monmouthshire—Coke and coke ovens.
1147. R. Walker and A. McKenzie, Glasgow—Electric telegraphs.
1148. W. Norris and R. King, Liverpool—Anchors.
1150. J. Leck and A. Miller, Glasgow—Singeing textile fabrics.
1152. H. Greaves, New Palace-yard—Permanent way of railways.
1153. C. R. Williams, Shiffnal—Implement for the cultivation of land.
1154. R. A. Brooman, 166, Fleet-st.—Stuffing seats, cushions, furniture, and other similar articles.
1155. S. W. Moore, Nottingham—Dividing and finishing lace goods.
1156. W. Marychurch and J. Griffiths, Haverfordwest—Horse-rakes, part of which is applicable to two-wheel carriages.
1157. M. Townsend, Leicester—The manufacture of knitted fabrics.
1158. W. Smith, 10, Salisbury-st., Adelphi—A new application of the syphon as an irrigator, and a motive-power machine.

Dated 16th May, 1856.

1159. W. Thistlethwaite, 2, Verulam-buildings, Gray's inn—Photography.
1161. W. Harker, Victoria Mill, Bowley, Bradford—Giving motion to rotating shuttle-boxes of power-looms.
1162. W. Henderson, Dunkeld, Perthshire—Manufacture of brooms.
1163. E. Eaborn and M. Robinson, Clement-st., Birmingham—Machinery for grinding or reducing sugar.
1164. A. Barclay and J. Wallace, Kilmarnock—Apparatus for the manufacture and measurement of illuminating gas.
1165. J. Mellor, Gorton, Manchester—Grates or grids, applicable to sewers and other similar purposes.

Dated 17th May, 1856.

1166. R. Coleman, Chelmsford—Implements for ploughing, hoeing, and scarifying land.
1167. D. Curwood, George-st., Grosvenor-sq. — Facilitating the cleaning of knives and forks.
1168. S. C. Kreeft, Fenchurch-st. — Manufacture of iron and steel.
1169. A. V. Newton, 66, Chancery-la. — Machinery for forging or pointing wrought nails, spikes, and other four-sided articles.
1170. G. Sheurmann, 86, Newgate-st.—Printing music.
1171. L. Cornides, 4, Trafalgar-sq.—Ornamental window blinds, and such like transparent decorations.
1172. J. J. Meyer, 28, Tatham-st., Molesworth-st., Rochdale—Machinery for mortising, tenoning, rounding, sweep and straight moulding, boring, grooving, and mitreing.
1173. J. Hynam, 6 and 7, Princes-sq., Wilson-st., Finsbury—Manufacture of instantaneous lights when of paper or cotton.
1174. C. Titterton, Roehampton—Manufacture of zinc and zinc white.
1175. R. Knight, Foster-la.—Apparatus for ærating liquids.
1176. R. McCloy and J. Hare, Glasgow — Spinning and twisting fibrous materials, and in the machinery employed therein.
1177. Lieut.-Col. C. C. Tevis, Paris—Revolver.
1178. G. Carter, Mottingham, Kent—Mode of propelling and steering vessels, and in the machinery applicable thereto.

Dated 19th May, 1856.

1179. J. Wilkes, T. Wilkes, and G. Wilkes, Birmingham—Manufacture of rollers or cylinders for printing fabrics.
1180. J. Brown, Kingswinford—Machinery for the manufacture of iron.
1181. J. Leakey, Bowhay, Modbury—Drills for sowing seeds and distributing manure or water.
1182. G. Clark, Great Cambridge-st., Hackney-rd. — Improvements in the manufacture of illuminating gas.
1183. M. H. Picciotto, 8, Crosby-sq.—Preparing flax, hemp, and other similar fibrous materials.
1184. J. K. Smythies, 27, Kensington-park-grdns.—Apparatus for ascertaining the points of the compass, and the latitude and longitude of a place.
1185. J. Wilkes, T. Wilkes, and G. Wilkes, Birmingham—Manufacture of rollers or cylinders for printing fabrics.

Dated 20th May, 1856.

1186. W. Fowler and W. McCollin, Kingston-upon-Hull—Portable steam-engines, applicable to agricultural and other similar purposes.
1187. W. Maugham, Ifield ter., Surrey—Rendering wood fire-proof.
1188. G. Wilkinson, 17, Evans-st., Poplar—Steering apparatus, and giving motion to machinery for raising and moving weights.
1189. W. Maugham, Ifield ter., Surrey—Rendering cotton and other fabrics and paper uninflammable.
1190. R. Maxwell, 4, Carlton-ter., North Brixton—Construction of taps for drawing off liquids.
1191. J. A. Gollop, 74, Lower Sloane-st., Chelsea—Method of excluding dust and other extraneous matters from doors, show cases, and such like constructions.
1192. S. R. Toms, 3, Church-vils., Croydon—Gloves.

1193. W. C. McBride, Armagh—Machinery for scutching flax and other vegetable fibrous substances.
1194. A. V. Newton, 66, Chancery-la.—Mode of preparing the double chlorides of aluminium and sodium, and aluminium and potassium.
1195. W. E. Newton, 66, Chancery-la.—Process of manufacturing oil from seeds, and in the machinery to be used therein.
1196. A. V. Newton, 66, Chancery-la.—Rotary pump.

Dated 21st May, 1856.

1197. J. H. Reynell de Castro, Manchester—Method of propelling railway or other carriages up inclines.
1198. D. Shaw, Gee-cross, Chester—Looms and apparatus employed therewith for weaving.
1200. J. Perrons, 53, Buddesland-st., Hoxton New-town—Ornamenting surfaces of wood, ivory, bone, and such like substances.
1201. A. H. Dufresne, 39, Rue de l'Echiquier, Paris—Process of gilding and ornamenting steel and other metals.
1202. J. Cope, Birmingham—Manufacture of buttons made of pearl or other shell, ivory, &c.
1203. M. Bower and J. Barwell, Birmingham—Method of joining the parts of metallic and other bedsteads and other articles of furniture.
1204. H. Medlock, 20, Great Marlborough-st.—Manufacture of glass, enamels, and other vitrified substances.
1205. J. Holdin and W. J. Dorning, Manchester—Bouking, bleaching, washing, and cleansing, textile fabrics and materials.
1206. A. Allan, Perth, and T. Hunt, Crewe—Construction of locomotive and other steam-engines and carriages, and in the rolling stock of railways.
1207. G. Heron, South-st. Newcastle-on-Tyne—Machinery for raising, lowering, &c., heavy bodies.
1208. R. H. Schwabe, Glasgow—Manufacture of ornamental fabrics.
1209. M. Neilson, Thorn Mill, Renfrew, N.B.—Treatment or finishing of yarns or threads
1210. E. Greenlees, Glasgow—Manufacture of textile and pulpy materials.
1211. C. de Jongh, Lautenbach, Gubewiller, France—Method of separating and assorting combed fibres of different lengths.
1212. T. Lawrence, Birmingham—Machinery to be used for grinding and polishing gun barrels, swords, and other articles similar in transverse section to any of those above named.
1213. E. H. Bentall, Heybridge, Essex—Crushing or splitting grain or seeds.
1214. W. E. Newton, 66, Chancery-la.—Machinery for spinning or twisting fibrous substances.
1215. W. H. Aston and S. Hopkinson, Zetland Mill, Huddersfield—Steam-boiler furnaces and apparatus employed for supplying water to steam boilers.
1216. W. J. Curtis, 1 Sebbon-st., Islington—Manufacture of iron railway-wheels.

Dated 22nd May, 1856.

1217. W. Galloway and J. Galloway, Manchester—Steam boilers.
1218. A. Hubert, Capt. in the Navy, Bordeaux—Apparatus for ventilating ships or vessels.
1219. J. C. Pearce, Bowling Iron Works, Bradford—Apparatus for generating and economising steam.
1220. W. R. Hodges, Manchester—Machinery for manufacturing loop-pile fabrics.
1221. W. C. Dempsey, 4, Liverpool-st., King's-cross—A compound for removing all obstructions of the air passages.
1222. A. Tolhausen, 7, Duke-st., Adelphi—Clock-work, part of these improvements being applicable to other regulating purposes.
1223. J. Cutler, Sparkbrook, Birmingham—Manufacture of metallic pipes or tubes to be used for various purposes.
1225. G. Barruel, 24, Rue Hautefeuille, Paris—Treating cotton seed.
1226. R. Bell, 93, Glassford-st., Glasgow—Manufacture of ornamental fabrics.
1227. C. Dewick, senr., Stanley-st., Leicester—Machines, generally called "rib frame or rib machine," for producing fancy hosiery.
1228. G. Howard, Bedford, and G. W. Baker, Woburn—Machinery applicable to the tilling of land.

Dated 23rd May, 1856.

1229. T. D. Russum, Tipton—Brake for steam-engines and other motive-power engines.
1230. S. Berrisford, Portwood, Stockport, and E. Wilkinson, Oldham—Looms.
1231. J. Gedge, 4, Wellington-st., South, Strand—Gridiron.
1232. J. Gedge, 4, Wellington-st., South, Strand—Looms.
1233. J. Gedge, 4, Wellington-st., South, Strand—Machinery for winding threads.
1234. J. Gedge, 4, Wellington-st., South, Strand—Obtaining a material used in dyeing.
1235. J. Gedge, 4, Wellington-st., South, Strand—Machinery for the manufacture of billiard cues or other similar articles.
1237. J. Gedge, 4, Wellington-st., South, Strand—Application of distillation to gas from the furnaces of steam-engines.
1238. G. B. Galloway, 42, Basinghall-st.—Furnaces of marine boilers, and in the construction of steam-vessels.
1239. T. Herbert and E. Whitaker, Nottingham—Manufacture of warp-lace fabrics.
1240. J. Dixon, High Bridge, Newcastle-upon-Tyne—Apparatus for measuring water and other liquids.
1241. F. P. Dimpfel, Philadelphia—The construction of screw-nuts for axle-boxes, and other purposes.

Dated 24th May, 1856.

1242. J. de Cockkenifeck, Cork—Process for preparing, refining, and filtering oils or fatty matters.
1243. P. E. L. Barron, Coleshill-st., Eaton-sq.—Process for coating metals for sheathing ships and for other purposes, and in the means of attaching sheathing-plates to ships or vessels.
1244. W. Illingworth, Manchester—Printing or colouring and glazing china, earthenware, or other ceramic manufactures, and in the machinery or apparatus connected therewith, and also improvements in the subsequent treatment of such manufactures.
1245. A. D. Jundzill, 18, Portugal-st., Lincoln's-inn-flds.—Instrument for animating stereoscopic figures.
1246. R. A. Whytlaw and Alexander Mitchell, jun., Glasgow—Weaving.
1247. J. Lea, Birmingham—Sun blinds.
1248. F. P. Dimpfel, Philadelphia—The construction of steam-boilers and furnaces.
1249. S. D. Liptrap, Albany-rd., Camberwell, and J. Wright, 10, Alfred-pl., Newington-causeway—Apparatus for regulating the mode of supplying and drawing off water and other liquids.

Dated 26th May, 1856.

1250. B. N. de Buffon, 13, Rue du Cherche, Midi, Paris—Apparatus for clarifying and purifying water and other liquids.
1251. A. A. Gaget, 39, Rue de l'Echiquier, Paris—Book-binding.
1252. A. R. M. de Normandy, 67, Judd-st., Brunswick-sq.—Obtaining fresh water from salt water.
1253. W. Rye, Manchester—Fixing or fastening rails or railways in their chairs.
1254. W. Hulse, Birmingham—Metallic and other bedsteads, which improvement or improvements may be applied to other articles of furniture, and to framework generally.
1255. C. Cowper, 20, Southampton-bldgs., Chancery-la.—The treatment of coal, and in the purification, dessication, and agglomeration of coal, and in machinery and apparatus for such purposes.
1256. B. J. Heywood, Leicester-sq.—Holders for lead, slate, and other marking materials.
1257. F. C. Jeune, Gresham-st. — Manufacture of floor-cloth.
1258. W. E. Newton, 66, Chancery-la.—Quadrants and other instruments for taking the altitude of the sun or other objects.
1259. T. Foster, Brownlow-st.—Apparatus for holding postage and other stamps.
1260. S. Newington, M.D., Ticehurst—Destroying the fly or aphis, and other insects, on hop and other plants.
1261. J. Roberts, Falmouth—Machinery for moulding bricks and tiles.
1262. T. Charlton, Brentwood, and W. Turnbull, Rotherhithe—Steam-engines.
1263. J. Baird, Edinburgh—Method of freeing the wool upon skins from burrs and other extraneous substances.
1264. H. G. Yates, East Smithfield—Treating wash waters in order to precipitate the greasy and soapy matters contained therein.

Dated 27th May, 1856.

1265. E. Talbott, Spring Vale, Staffordshire—Construction of rails for railways.
1266. F. C. Hills, Deptford—Purification of gas.
1267. W. E. Newton, 66, Chancery-la.—Printing machinery.
1268. A. V. Newton, 66, Chancery-la.—Reaping machines.
1269. F. P. Dimpfel, Philadelphia—Constructing the permanent way of railroads.

Dated 28th May, 1856.

1270. L. D. Owen, Southampton-st.—Manufacture of artificial stone.
1271. J. Macdonald, 13, Henry-st., Up. Kennington-la., Vauxhall—Reflection, emission, and radiation of light and heat for lamps, and other useful purposes.
1272. J. Clark, Buckskin Farm, Basingstoke—Horse hoe.
1273. W. Fulton, Glasgow—Preparing and spinning fibrous materials, and in machinery or apparatus employed therein.
1274. C. H. Holt, Manchester—Steam-boilers, furnaces for the same, and apparatus connected therewith.
1275. G. Bell and G. C. Grimes, 1, Vauxhall-walk—Manufacture of frictional matches and fuzees.
1276. R. A. Brooman, 166, Fleet-street—Coating or composition to be applied to substances in order to render them uninflammable, and in the method of and apparatus for manufacturing the same.

Dated 30th May, 1856.

1278. H. J. van den Hout, Covent-garden—Preparation of pulp for the manufacture of paper, millboard, and other purposes.
1279. A. Drew, Glasgow, and M. Gray, Bonhill—Weaving.
1280. D. Bethune, Cambridge-ter., Hyde-pk.—Apparatus for dyeing.
1281. W. C. Hutton, Sheffield—Stamps or hammers worked by power.
1282. J. Weems, Johnstone, N.B., and J. H. McCrindell, Glasgow—Manufacture or working of metals and their ores.
1283. F. L. Stott, Rochdale, and T. Belward and J. Findlow, Manchester.—Machinery for washing wool or garments, and other articles made of textile fabrics.
1284. J. H. Heal, 196, Tottenham-court-rd.—Hair and wool mattresses.

Dated 31st May, 1856.

1285. A. Bouvallet, 39, Rue de l'Echiquier, Paris—Printing woven fabrics and like materials.
1286. F. A. Calvert, Manchester—Machinery for opening and carding cotton and other fibrous materials.
1287. A. Watson and A. H. Williams, Cornhill—Bottles, flasks, and other like receptacles for liquids.
1289. F. Allman and D. Bethune, Cambridge-ter., Hyde-pk.—Apparatus for separating fluids from solids, or for separating the more fluid particles from the more solid of various bodies.
1290. H. Bessemer, 4, Queen-st. pl., New Cannon-st.—Shaping, pressing, and rolling malleable iron and steel.
1291. R. Jobson, Wordsley—Apparatus for making moulds for casting metals.
1292. H. Bessemer, 4, Queen-st.-pl., New Cannon-st.—Improvements in the manufacture of iron and steel.
1293. W. Gossage, Widnes—Manufacture of certain kinds of soap.
1294. D. Spink, Bridgwater—Rails and railways.
1295. Capt. Francis Fowke, R.E., Pall-mall—Portable photographic camera.

Dated 2nd June, 1856.

1296. R. Blackwood, sen., Kilmarnock—Machinery for doubling yarns or threads.
1298. T. Wilson, Birmingham—Screw-wrenches.
1300. S. R. Parkhurst, New York—Paddle-wheels for steam-boats.
1301. B. J. Heywood, Leicester-sq.—Holder for leads and other marking materials.
1302. L. A. Dieudonné, 35, Essex-st., Strand—Nose-bags.
1303. A. Cadet, 36, College-st. North, Camden-town—Stamp inking apparatus.
1304. A. M. Herland, Paris—Regulator pen-holder.
1305. V. J. Baptiste Mauban, 39, Rue de l'Echiquier, Paris—Cans for holding oils, &c.
1306. J. E. McConnell, Wolverton—Locomotive engines.
1308. J. Nasmyth, Patricroft, and J. Brown, Newport, Monmouth—Apparatus for the manufacture of tin plates.
1309. J. Groley, Paris—Plough.
1310. E. Marsden, Hanley-wood, Derby—Implements for pulverizing and cleaning land.
1311. W. Beadon, Otterhead, Honiton—Agricultural implements for cleaning, cultivating, and rolling land.

Dated 3rd June, 1856.

1313. T. W. Willett, 89, Chancery-lane—Manufacture of gunpowder.
1314. G. J. Mackelcan, Islington—Manufacture of rollers adapted to calico and other printing.
1315. E. Heywood, Sutton-cross-hills, Leeds, and T. Ogden Dixon, Steeton, Keighley—Attaching drawer and other knobs or handles.
1316. C. R. Wessel, 25, Fitzroy-sq., New-rd., and F. X. Kukla, 3, Raven-rw., Mile-end-rd.—A vapourless glow-heat disseminator.
1317. J. Bauzemont, Paris—Purifying turpentine.
1318. J. H. Johnson, 47, Lincoln's-inn-flds.—Oil cans employed in lubricating machinery.
1319. W. G. Whitehead and F. A. Harwood, Birmingham—Candlestick.
1320. J. J. Lebaillif, Falaise, France—Beating and dressing cotton, and other similar fibrous substances, and woollen cloths.
1321. R. Fletcher, Derby, and E. Fletcher, Monk Bretton, York—Sweeping chimnies, &c.
1322. M. R. Leverson, 12, St. Helen's-place—Tackle-blocks.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1288. W. Needham and J. Kite, Vauxhall—Machinery for expressing liquids or moisture from substances—31st May, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.
May 15, 3837. W. Aston, Birmingham, "The New Union or Alliance Buckle."
,, 16, 3838. W. Aston, Birmingham, "Improved Spring-Fastening for securing the covers of small fancy and other boxes used for holding small wares, such as buttons, pens, hooks and eyes, &c., such articles as are usually made up and sold in boxes."
,, 19, 3839. W. Adsetts, Sheffield, "Improved Double or Single-Action Rotary Carpenters' Brace Heads."
,, 21, 3840. Dent, Allcroft, and Co., 97, Wood-st., Cheapside, "Dent's Perfected Collar."
,, 23, 3841. E. Kesterton, Long-acre, "The Derwas Curricle and Harness."
,, 26, 3842. R. Wnygood, Newington Causeway, "Improved Lever Cask Stand."
,, 26, 3843. Cope and Collinson, Birmingham, "Improved Lock."
,, 26, 3844. J. Gillott, Birmingham, "Penholder."
June 6, 3845. J. E. McConnell, Wolverton, "Live Ring Turntable."
,, 6, 3846. J. Paterson, 104, Wood-st., Cheapside, "Improved Shirt Front and Collar."
,, 6, 3847. Lieut. Philip Harris, H.M. Royal Marines, Chatham, "The Service Canteen."
,, 7, 3848. J. C. Stokes, Birmingham, "Portable Water-closets."
,, 11, 3849. J. B. Dancer, Manchester, "Improved Magneto-Electric Machine."

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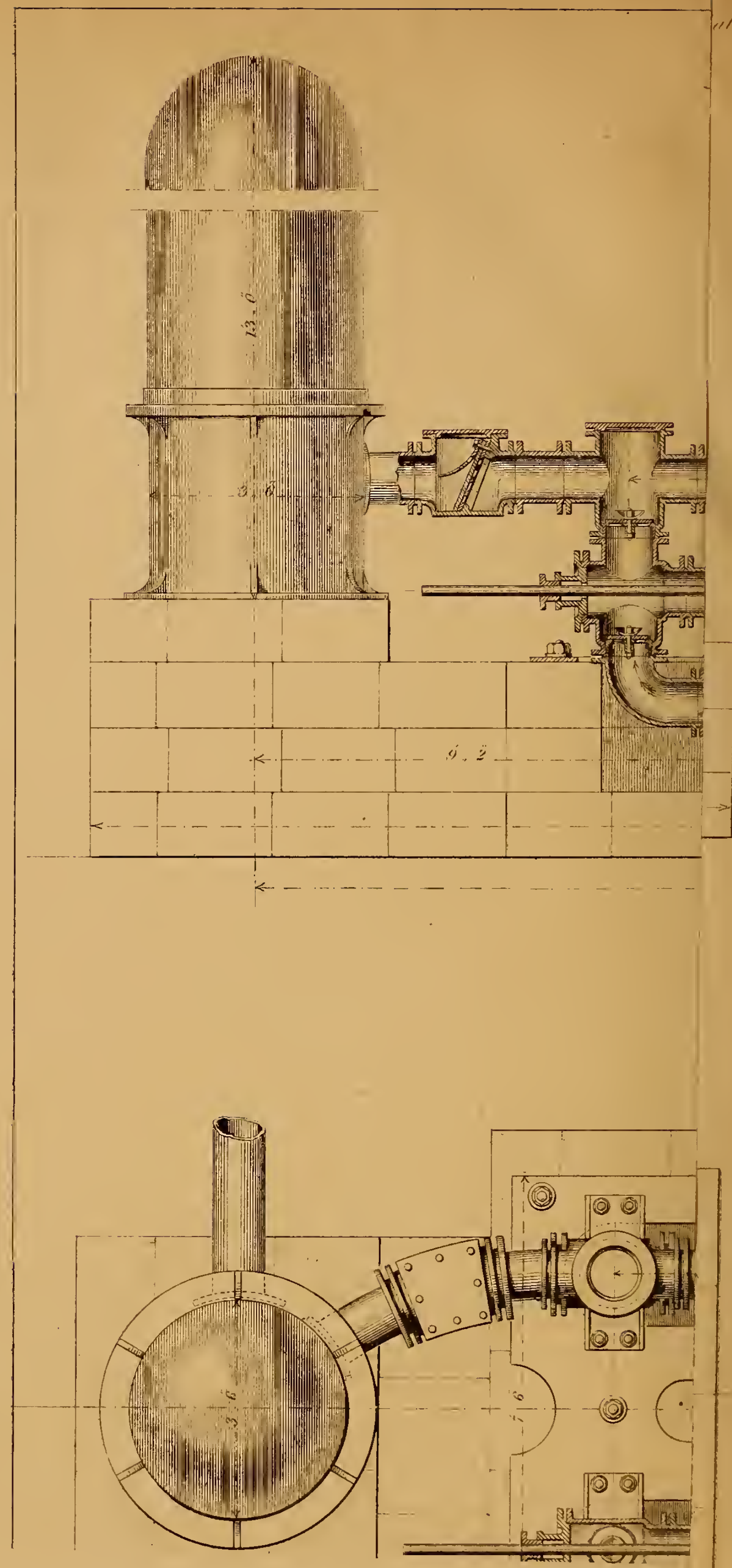
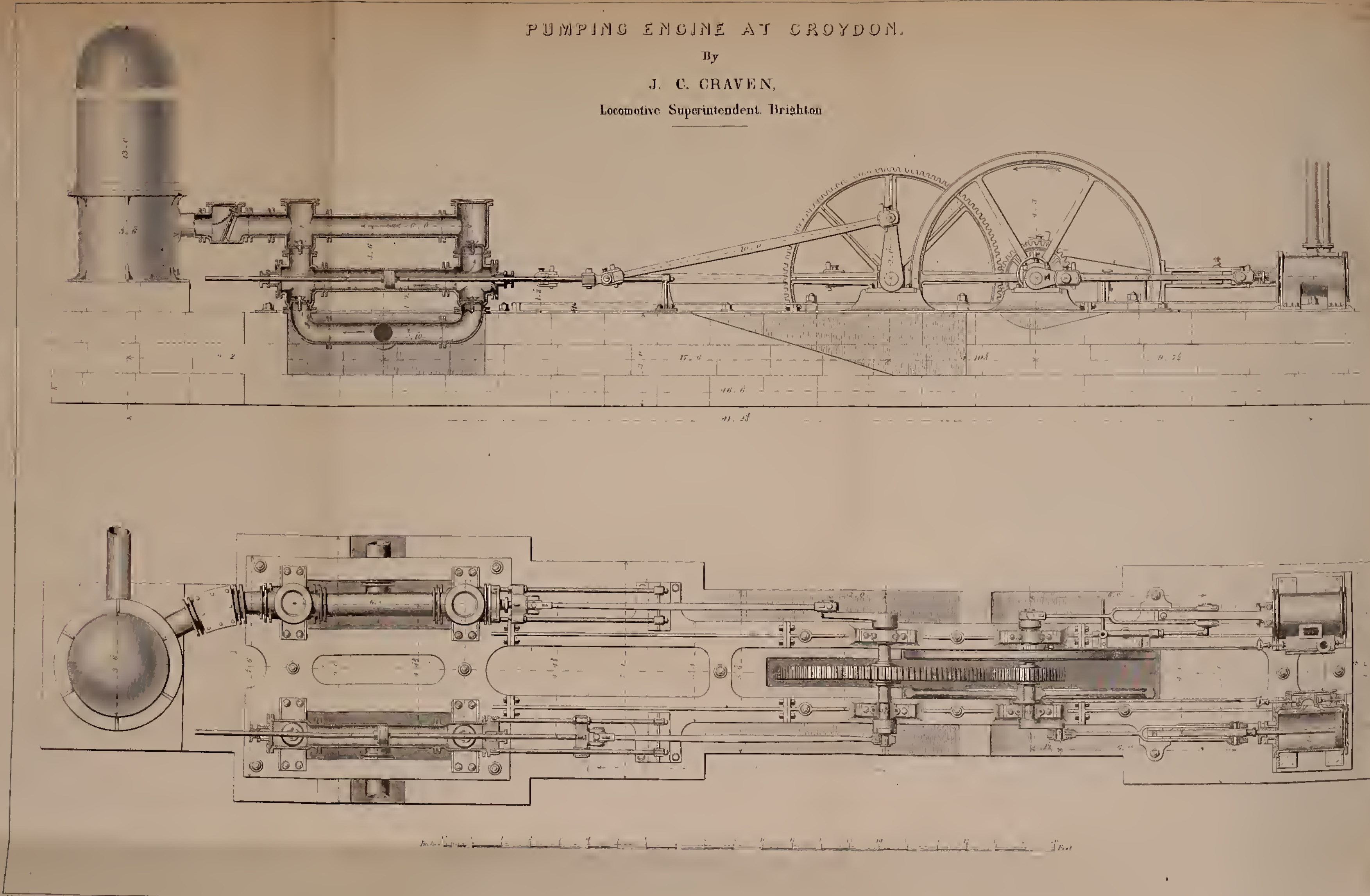


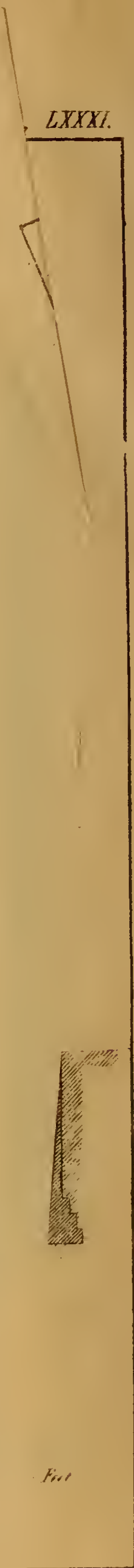
PUMPING ENGINE AT CROYDON.

By

J. C. CRAVEN,

Locomotive Superintendent. Brighton





WATER-WORKS ENGINES

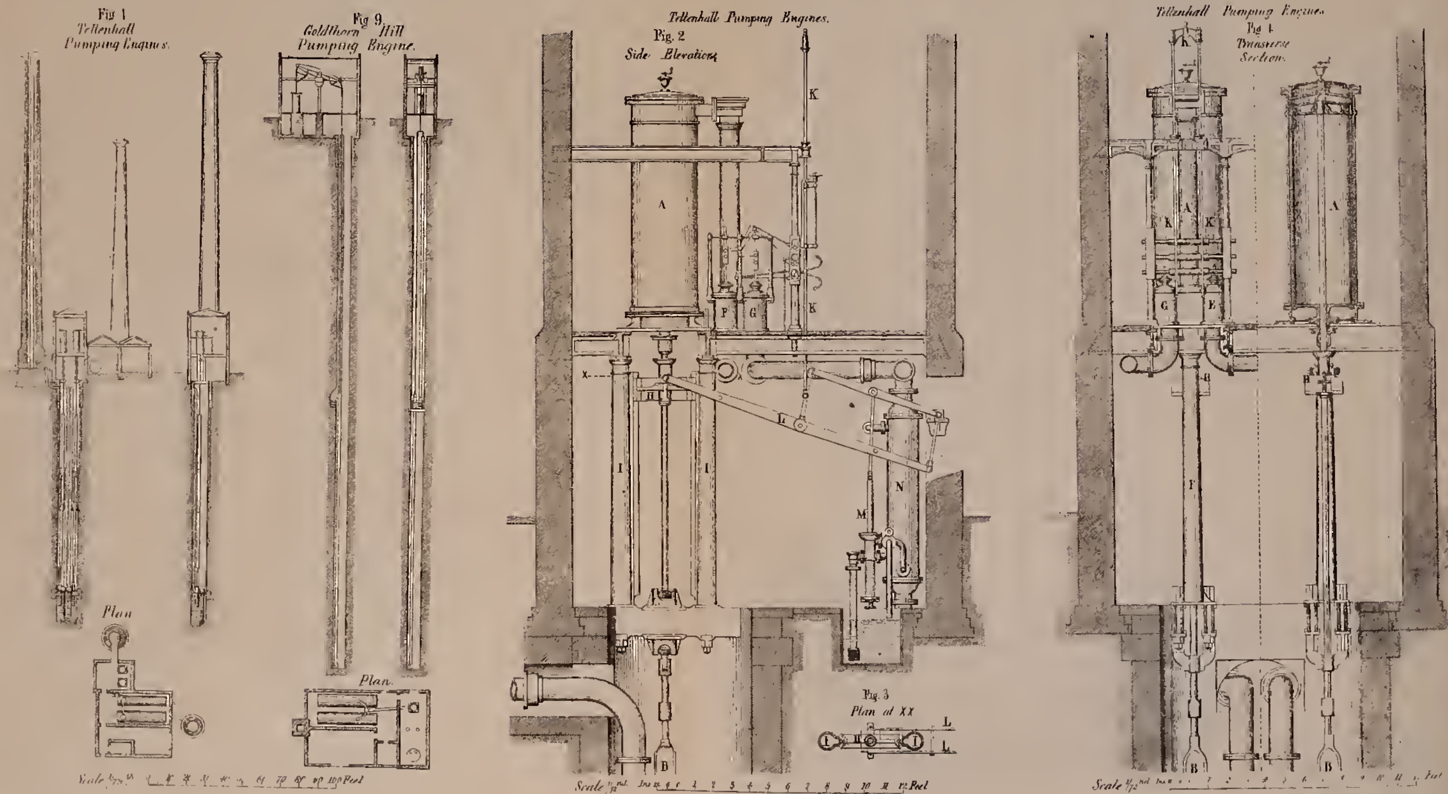
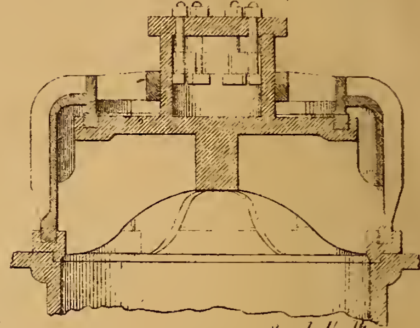


Fig. 14
Harvey and West's Double-Beat Pump Valve



Scale 1/12th

Fig. 15.
Hestang's Valve

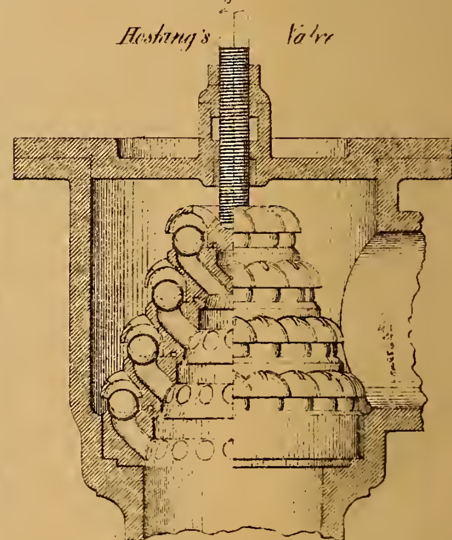
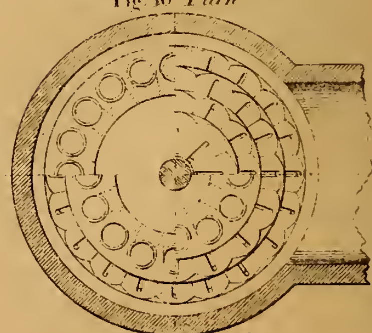
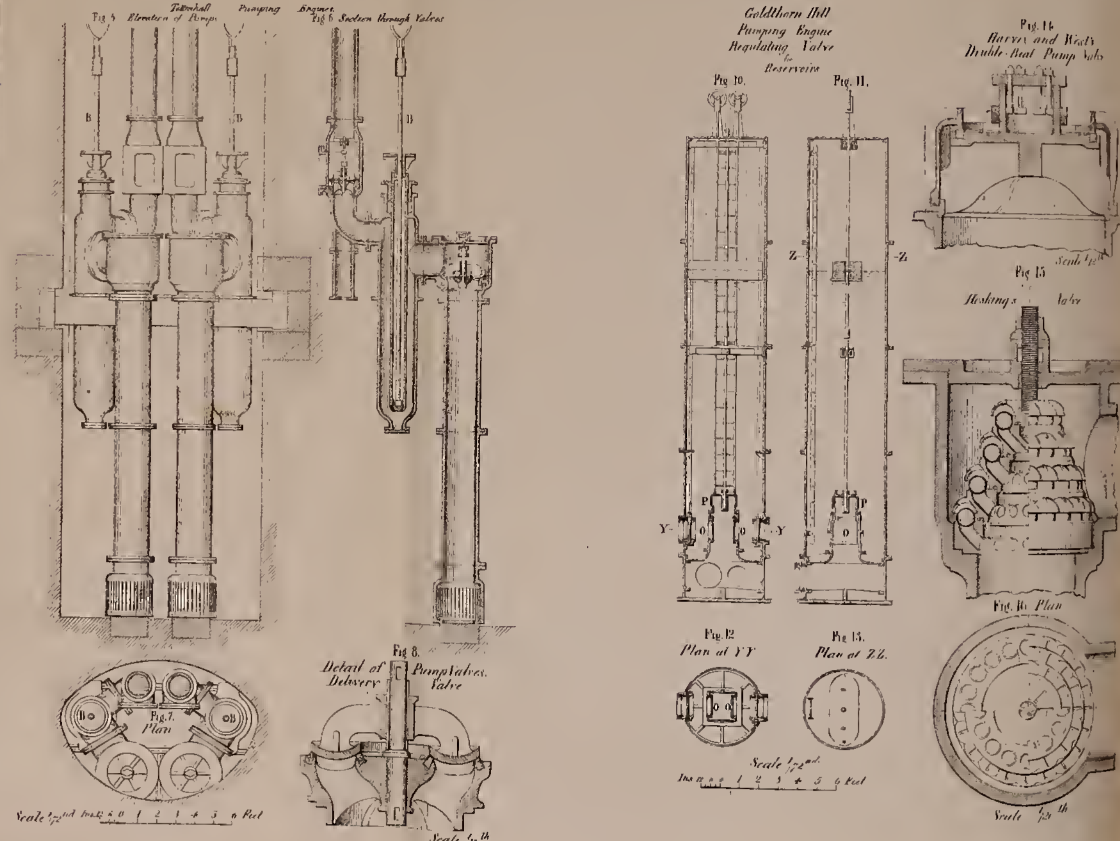


Fig. 16 *Plan*

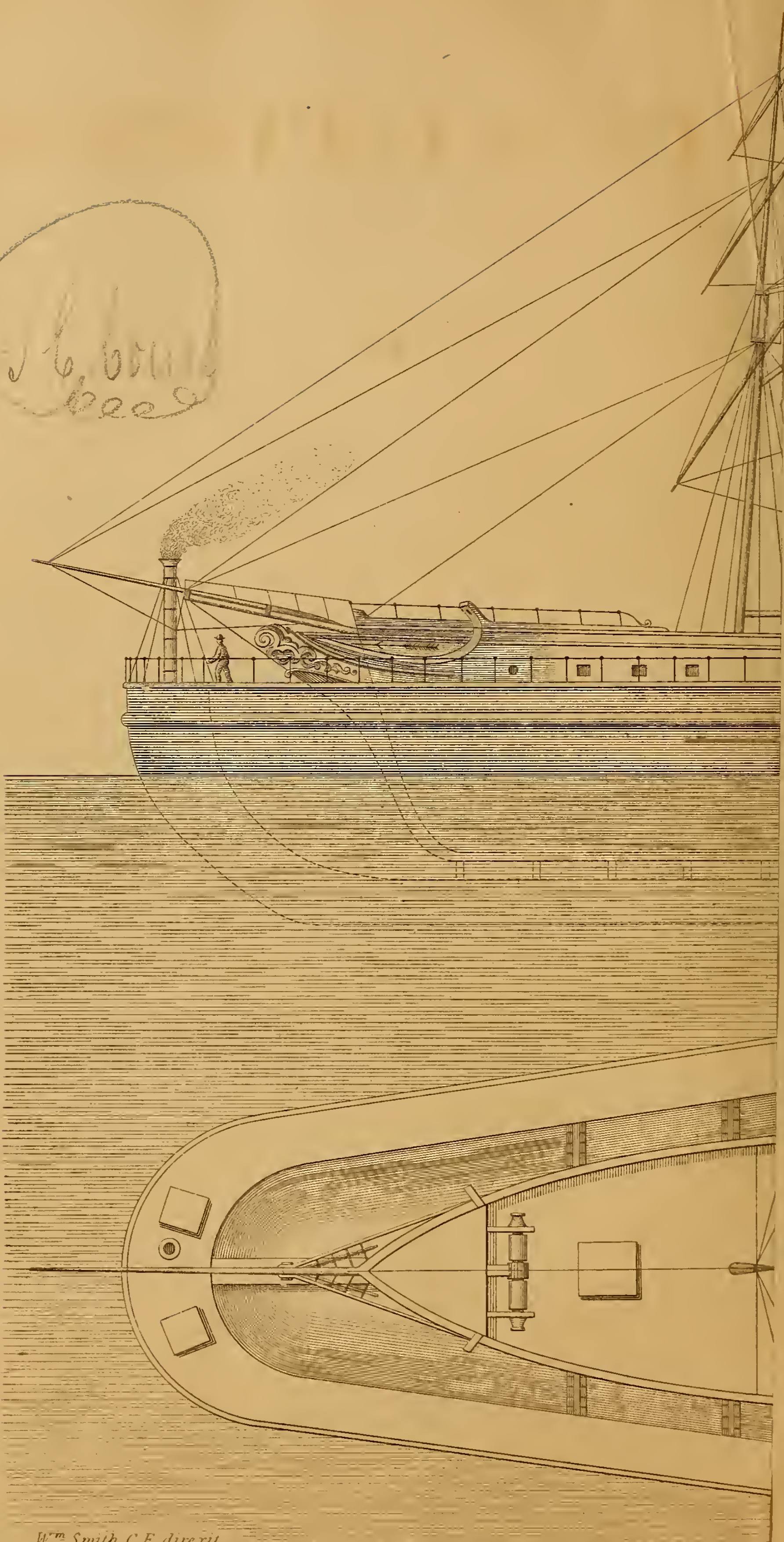


Scale 1/20th

WATER - WORKS ENGINES.



W. Smith C.E. Direx.



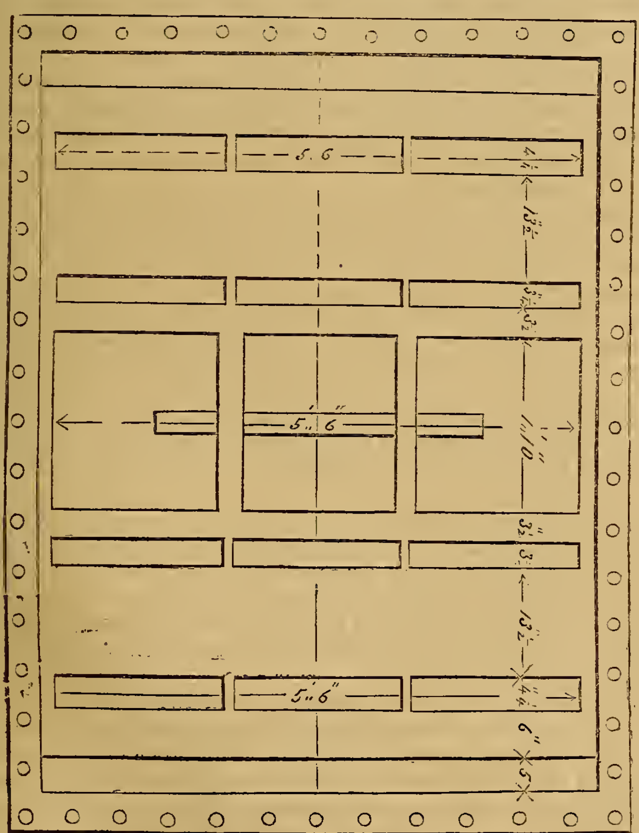
W.ᵐ Smith, C.E. direxit.

THE ARTIZAN.

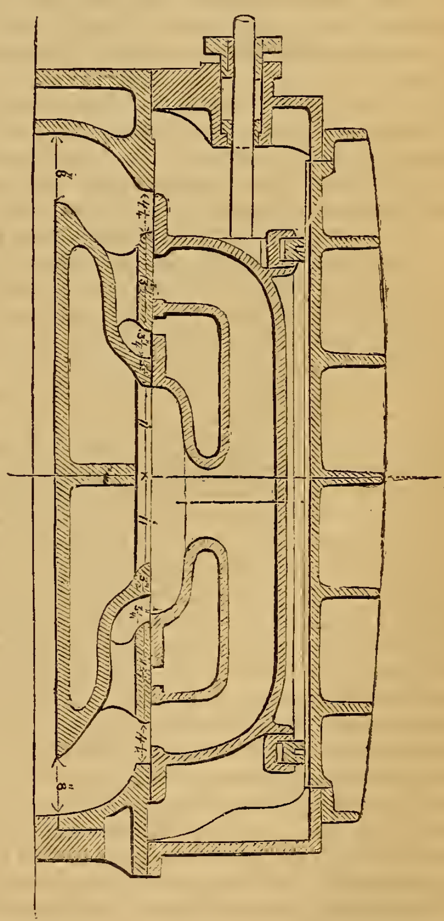
No. CLXIII.—Vol. XIV.—AUGUST 1st, 1856.

JAMES WATT AND CO.'S SCREW ENGINES FOR THE EASTERN STEAM NAVIGATION COMPANY'S GREAT SHIP.

Continuing our remarks upon the construction of these engines (see our June Number, pages 121 and 122), we have to observe that the Plate published in our last Number represents a plan of these screw engines, and of one set of boilers, of which there are three apportioned to the screw machinery, and two to Mr. Scott Russell's paddle-engines.



PLAN OF CYLINDER PORTS.



SECTIONAL ELEVATION OF SLIDE VALVE AND CYLINDER PORTS.

The large engine-shaft, it will be observed, is in two portions, joined in the centre by a large cast-iron disc, 8 ft. in diameter, and about 2 ft. 6 in. thick; or, say 15 in. each side.

This disc is cast solid on one side, so as to *balance* the cranks and connecting rods, &c.; and which device, it is well known, materially improves the working of direct-acting, or quick-going engines. Upon the periphery of this disc (not shown in plate) will be placed a screw wheel, and by means of a worm or screw mounted on a vertical shaft running up to the deck, and terminating in a capstan-head, the engines may be turned by hand; and, by an arrangement for dropping the screw or worm out of gear with the wheel, it can be readily disconnected.

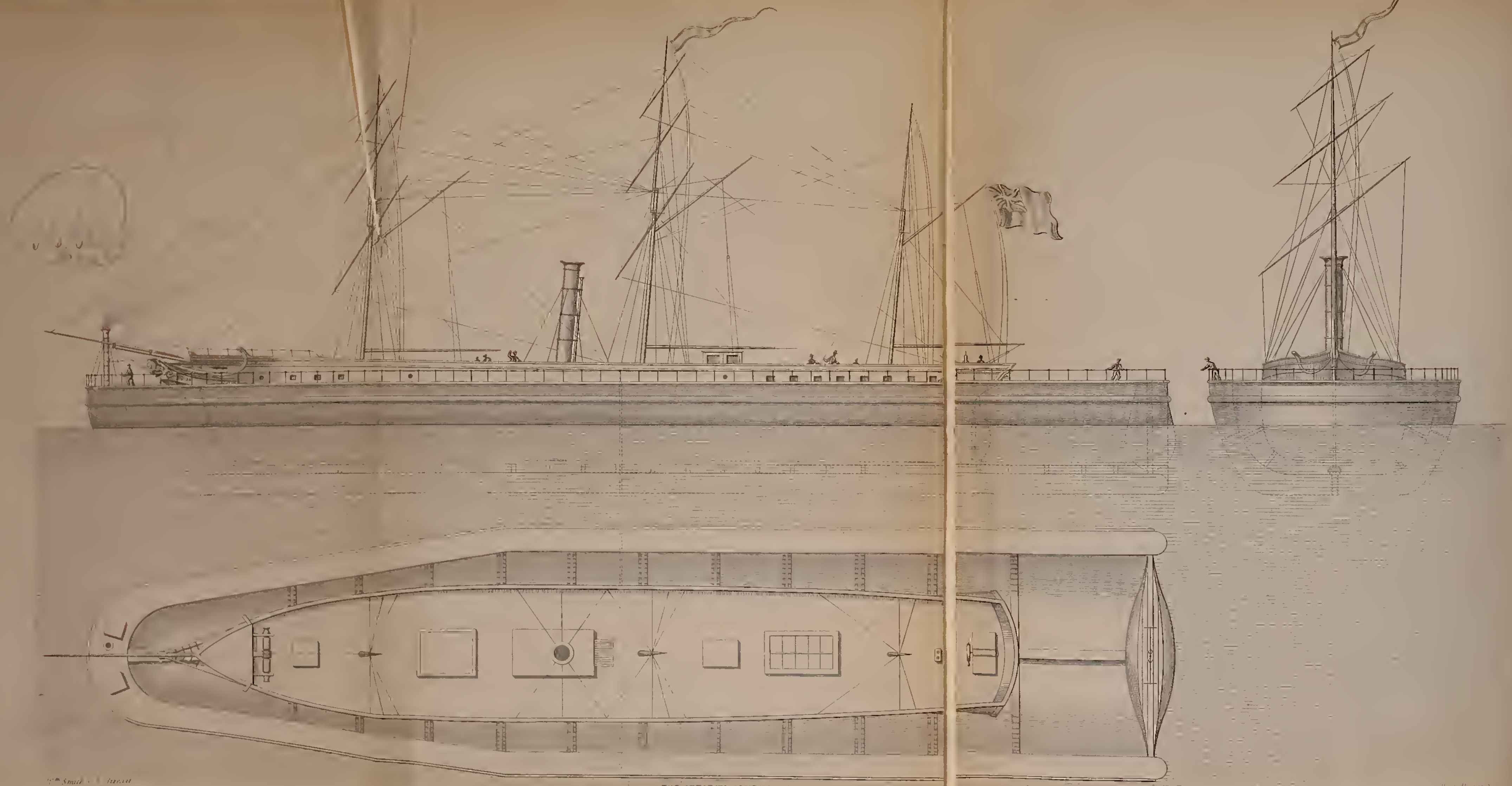
The diameter of the necks of these shafts is 23 in., and the length of *each* bearing 33 in.; and the weight of each shaft, exclusive of the cast-iron disc, is 15 tons—therefore, 30 tons for both.

They have been forged by Messrs. Mare and Co., of Blackwall, and are now nearly completed. The work has been arduous and difficult, from the enormous mass of material contained in them; but it has been ably effected, much to the credit of Mr. William Hardy, the manager of the forging department of Messrs. Mare and Co.'s works.

It will be seen that each cylinder has two piston-rods, each 7½ in. diameter, and that the air-pump is worked from the end of the cross-bar. The piston itself is 27 in. thick, giving ample rubbing surface, and there

Plate 13

TAYLOR'S PATENT FLOATING GRAVING DOCK.



are lateral guides upon the engine frames; the whole, therefore, is well calculated to resist any angular thrust arising from this arrangement.

The connecting rods are upon the American principle: the one composed of *two* rods, each 7½ in. diameter, the other of *four* rods, each 5½ in. diameter; the ends are formed of *cast-iron* blocks, into which they are fastened; they are filled in with Babbit's metal. The main shaft is also supported in a similar manner—namely, by immense cast-iron blocks (in place of brasses), filled in with the white metal in the usual way.

The air-pump, as before observed, is worked from the piston-rod cross-bar, and, therefore, has a stroke of 4 ft., the same as the piston of the engine itself. The diameter of this pump is 25 in.; the valve chambers at each end are of most ample dimensions, and the areas of the valves themselves very large, so as to insure a free discharge of the condensing water, &c. It is proposed to carry the waste water pipes *above* the water-line, as represented in the plate published in June, and to deliver the products of the engine into a large chamber formed between two lower deck beams of the ship, and thence down the side, and so allow all to pass off freely by its own gravity.

It is also proposed to make this chamber a general receptacle for all the blow-off water from the boilers, by which means very many perforations in the bottom of the ship will be avoided.

The steam-slides of the engines are placed vertically upon the outer sides of the cylinders, and they are made upon what is called the double-ported plan, by which means, as is well known, very large areas may be obtained, and the stroke or travel of the slide be reduced to a minimum.

In the slides of these engines, the ports are each 3¾ in. wide, say 7½ in. together, the length of port being 66 in. The total area of port for each end of the cylinder is 495 sq. in., a large proportion, and which will give a quick and efficient clearance to the cylinder, as will be seen by the accompanying diagrams of the cylinder, ports, slide, &c.

The steam, upon leaving the cylinder, passes over its top by the curved iron pipe, and which is purposely raised to prevent the condensing water getting into the slides, and thence into the cylinder. This bending or curving of the pipe also acts as an expansion-joint, for which purpose it is amply sufficient.

The condenser is in the centre of the hot water cistern, and entirely *above* the air-pump, so that every drop of water can be drained out of it, and a good vacuum insured.

All the valves in the engines, excepting the bilge pump-valves, will be of india rubber, a series of small round valves about 6 in. in diameter, the motion of their pumping being but 1¼ in., thereby making them most effective in their action, and very lasting aud durable.

The cross-section in the June number shows the double eccentric gear, and the plan by which the two slides (of opposite engines) are worked by one set of eccentric circles and rods. The link of the eccentrics is supported by a rod, which is attached to a piston in a small steam cylinder placed above, and it is prolonged to a balance weight as shown, by which means it is perfectly held in suspension, and in moving it the friction and vis inertia only have to be overcome.

The small steam cylinder referred to is 21 in. diameter, and its trunk is 12 in. diameter; it is provided with a small slide-valve, supplied with steam from the main steam-pipe, and exhausting into the large condensor; as the effective area of this piston is 233 sq. in., and the pressure of steam 25 lbs. per sq. in., there will be a pressure (*not* including any vacuum that may exist in the large condensor) of 2·6 tons to move the link, eccentric gear, and slides, and which it is pretty safely assumed is more than ample to reverse the engine, or otherwise, as may be desired.

Starting wheels are also arranged, by which a large manual power may be brought to bear upon these parts (in addition to the steam power) should it ever be required, and which starting wheels are so fitted that they may be instantly detached from the steam power.

Thus it is also safely assumed that this immense machine may be started, reversed or stopped by the exercise of about so much forec as would be necessary to move two very small slide valves, having a travel of 1½ in. only.

It will be observed that the general object with which this machinery has been schemed, is to make each of the four engines entirely independent of the others, should any accident happen to one, that it may (in reasonable time) be detached, and remain at rest.

Our general plan of the ship will show the arrangement of the boilers, and the manner in which they may be used to work either the screw or the paddle-engines.

The large steam-pipe, which is 45 in. diameter, passes forward in a water-tight trunk or compartment, having pipes and valves descending to each of the sets of boilers, the holes through which they pass having glands and stuffing-boxes to exclude water, and therefore making this trunk perfectly separate, and thoroughly cut off from the stoke holes.

The boilers are arranged by Mr. Scott Russell; the plan he adopted for his paddle-engines having been followed for the screw-engines—thus insuring uniformity in this important portion of the machinery.

In our June number we gave the general dimensions, surfaces, &c., of each set of boilers, and therefore have only to add that the method of cross-firing has been selected, as offering advantages in the consumption of the products of combustion, and so in the prevention of smoke; an ingenious apparatus is also, for the same purpose, fixed to admit hot or warm air behind the bridges. It will be seen the boilers have no *internal* uptakes (so fruitful a source of decay and danger); but the products of combustion, on emerging from the tubes, pass round *between* the boilers to the chimney, each set being provided with the requisite dampers and blowers. Of these boilers a drawing will be given hereafter.

One peculiarity in these engines will be noted: they have no *pumps* of any kind attached to them (excepting their own air-pumps), as before remarked, all the feeding of the boilers will be done by separate engines or "donkeys," placed in each stoke hole; and there are separate pumps and engines of considerable power to act as bilge-pumps, and for other purposes.

It will be observed in the cross section given in our June Number that two throttle-valves are shown upon each engine, as well as a compensating governor, having four balls. This kind of governor, we believe, was patented many years ago by the late Sir M. I. Brunel, and it is now adopted by Mr. I. K. Brunel, for the purpose of instantaneously correcting any variation in the speed of the engines, by reason of the alteration of the proportion of the power exerted to the resistance to be overcome at any moment, and to which the governors have been previously adjusted. Assuredly, the action of such a governor is admirably suited to the purpose for which it was originally designed, but we doubt the practical value of such a form of instrument to marine engines.

For the soundness of the judgment displayed in the adoption of the *four* small connecting rods, instead of having one of sufficient strength, we cannot say one word; indeed, it is remarkable that this is almost the only instance of want of good proportion and unity, as otherwise the working parts are generally well proportioned to the stationary masses, aud to each other; but we fear, notwithstanding the four rods are each 5½ in. diameter, that in a sea-way, on a rough Atlantic voyage, small as the amount of motion will necessarily be in so large a vessel, and uniform as the working of the four-bladed screw must be, there may be such an amount of tortion or sudden strain thrown upon one or two of the rods only as to render the remainder unfit for the work, and in such a case it is not difficult to foresee the result; and, however ingenious the governors used may be, they will not avail in such an occurrence; and although the engines are excellently arranged, so as to be disconnected in case of accident to any one of them, it would be better to provide against the possibility of accident.

In the space, shown in the plan view of the engines as between the after bulk-head of the screw engine-room and the eccentrics on the screw-shaft, it is intended to fix the two auxiliary engines, of 20 H.P. each, for moving the screw, when the large engines are disconnected therefrom, at such a velocity as will prevent the speed of the vessel being retarded when the ship is under way with the paddles alone, or when under sails and paddles.

The precise position of these engines, their boilers, and the gearing, not being definitively determined on, they were omitted from the plan view given in our last number. But in the course of our series of Plates of this great work of naval construction and engineering skill, the whole of the details of these and other arrangements of the ship and its machinery will be shown correctly.

Thus far we note in our present number, and as we proceed other points of interest will be duly brought before our readers; but we must reserve, until our next, any further remarks upon the subject, as we intend then to give the longitudinal section, plan view, &c., of the ship.

TAYLOR'S FLOATING GRAVING DOCK.

The accompanying Plate, No. lxxxiii., represents three views of an Iron Floating Dock, designed and patented by Mr. James Taylor, of the firm of James Taylor and Co., Britannia Works, Birkenhead, who is also the inventor and patentee of an excellent steam winch or crab, a steam crane, travelling hoist, and other similar contrivances for labour saving.

Great as is the importance of such an arrangement for docking ships in many situations along our own coasts, it is vastly greater in situations abroad, where no convenience whatever exists for the examination or repairs of the ships of our vast mercantile marine; and as the construction of docks in masonry is generally expensive abroad, and particularly so in our distant colonies and possessions, here is a ready and excellent contrivance in substitution. And remembering that it possesses this advantage, viz., that it can be completely built and equipped here, and can be steamed out or sailed out under jury-rig to its destination, we cannot but think that the great foreign going steam-ship companies and large shipowners are wanting in foresight, not to send out one of these Floating Graving Docks to each of the great foreign and colonial stations to which they trade, and which do not possess the facilities for the examination and repairs of ships, of the large tonnage now commonly built, and engaged in the commerce of the world.

It does not require a moment's thought to call to mind many instances in which steam-ships sailing from our own great commercial ports have—in consequence of meeting with some slight accident whilst clearing out, or when only just commencing their voyage—had to put back for examination, for which purpose always one, and frequently two or more tides, pass before the ship can be docked; and in many cases, after this delay and the cargo has been taken out, the actual repairs required only occupy a few hours. This was recently the case at Liverpool, where, after three weeks delay, and an expense of many thousands of pounds, the vessel was found to be almost uninjured. This delay and nearly the whole cost might have been entirely avoided, and the steam-ship have kept her time of departure, or at least her place in the list, had there existed in the port of Liverpool such a convenience as one of Taylor's Floating Graving Docks, large enough to have docked her with cargo on board, and irrespective of the state of the tide at the time of the vessel's return into port.

Abroad, it is frequently the case that large steamers and sailing-ships, in case of accident, are obliged to go considerably out of their way, and at an enormous cost to be examined; and, not unfrequently, have to come home to be docked for the purpose of examination only.

We may shortly allude to this subject again; in the mean time, we give the following general description of the Floating Dock:—

The dock is intended to be used as a Floating Graving Dock, and therefore requires no excavation or masonry, nor indeed any other land-works of any kind; but it is to be anchored in any safe and convenient place, where the water may be tolerably smooth, and can be easily moved from place to place, as may be required, according to convenience.

The dock is constructed of iron, with double sides, so that the ribs are all contained in the sides, leaving the dock flush outside and inside. It is provided with a floating-gate, or caisson, to stop the entrance when a ship has been taken in. There is an engine and pumps attached on board, for the purpose of emptying the dock when the ship is being properly shored. The process of docking a ship may briefly be described as follows:—

1st. The dock being full of water, but the sides not being full, it will float several feet above water, and in this state there is room for a ship to enter, and give ample working room all round at midships, and consequently much more at all other parts.

2nd. The entrance can either be provided with gates or a caisson—if the latter, after being floated at the entrance it is there moored fast, and the ship being properly shored from the sides, where there are provided steps or pockets on which the shores may conveniently take a bearing, the emptying of the dock at once commences, by first opening the sluices placed in the inside wall of the dock, to allow the body of water floating the vessel to pass into the double sides, until both are brought to the same level; thus dispensing with a great proportion of the water by natural gravity, when the remainder is discharged by means of the steam-engine working the pumps, thus leaving the sides of the ship perfectly dry, with ample room for the men to work, as in the case of an ordinary dry dock.

The vessel, with all her stores or cargo, could be put into the dock and raised above water level, or heeled, by pumping out the water contained in the double sides, without the necessity of putting the caisson across. It should also be noticed, that the amount of power to be exerted in thus pumping the inside of the dock dry, is by no means so great as in the case of pumping out an ordinary dry dock, because, as the dock is lightened, it rises in the water and floats higher, thus reducing the height of the lift of the pumps. It is, of course, obvious that the dock may be used for any smaller-sized vessel, or for two small ones at the same time. This can be accomplished, if for one small vessel, by the caisson being shifted nearer the top end of the dock, and pumping out the water from the double sides; the dock would then float higher, and lessen the amount of water to be disposed of, or the dock could easily be lengthened to any extent for larger vessels.

One of the incidental advantages attendant upon the use of this dock, for any distant station, would of course be the great facility in having the dock made complete here, but not entirely rivetted up, and sending it out in sections or pieces, ready to be put together at its destination. This dock was planned for distant stations, where there is little variation in the rise and fall of the tide; but as its mode of working is not dependent upon the tide, it is evident that in this country, where expedition is required, it might be made available for vessels that cannot gain admittance into docks so dependent upon the rise and fall of tides.

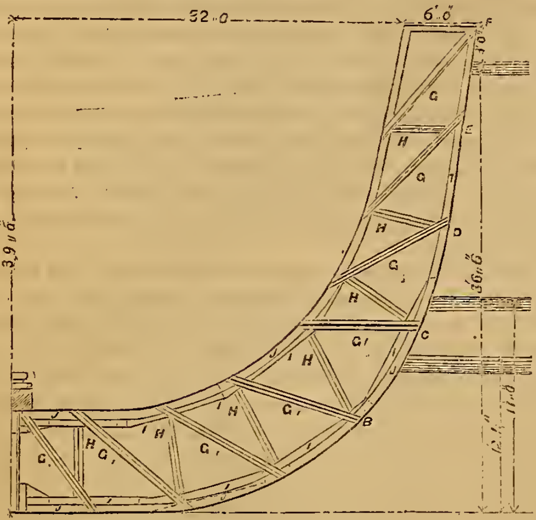
The following is a short specification of an iron floating dock which is about to be constructed:—

Floating Graving Dock, made of wrought iron, 300 ft. long × 64 ft. wide × 316 ft. deep inside. Double hull, made with compartments longitudinally and transversely; the compartments longitudinally made up by a double keelson up the centre, which are 8 ft. deep, and water-tight bulkheads, about 14 ft. from bottom, and transversely by bulkheads between the hulls, say three in number. The entrance closed with a caisson, and made to fit, not only at the entrance itself, but at different points, so that it may be made available for a short vessel.

An engine of about 20 H.P. placed at the head of the dock, having pumps with pipes leading to each compartment with sluices, so that the buoyancy can be regulated, or the power of heeling or canting over can be readily effected.

The walls of the dock are composed of boiler plates and ribs, in the usual way of an iron vessel:—The ribs of the outer hull inside, and ribs of inner hull outside; but both sets of ribs look in the direction of one another, and are braced with diagonal braces, and strengthened with extra plates as far as the bilges. The ribs, of T iron, are $7\frac{1}{2} \times 4\frac{1}{2}$ in.; the strengthening plates, 12 in. $\times \frac{1}{2}$ and $\frac{3}{8}$ in.; the diagonal braces of angles double rivetted back and back; those taking thrust, 4×4 in., and those acting as ties, 3×3 in., and $3\frac{1}{2} \times 3\frac{1}{2}$ in., lessening in thickness towards the top, where less strain is needed. The keelson, formed of two rows of $\frac{1}{2}$-in. plates, with angle iron 4×4 in. joined to the hulls, and the ribs, coming through keelson, strengthened with strengthening plates.

Hull of plates lap-jointed, $\frac{1}{2}$ in. thick, from keelson up 30 ft. one side, and from that $\frac{7}{16}$ in. up other 8 ft., and from that $\frac{3}{8}$ in. up other 11 ft., and the remainder $\frac{5}{16}$ and $\frac{1}{4}$ in. for the outside, and the same thicknesses correspondingly in the inside. The bottom to be provided with two lengths of timber placed over the keelson, bolted together, and fixed to the bottom with bolts; to have sliding wedges of cast-iron tapered to adjust for the keels of vessels to rest upon; these plaeed 10 ft. apart.



In the aceompanying section of a floating dock, constructed according the above design, the several lines of flotation are marked, and the following are the principal dimensions of the metal construction:—

DIMENSIONS OF PLATES, &C.

From A to B $\frac{1}{2}$ in. thick
" B to C $\frac{7}{16}$ "
" C to D $\frac{3}{8}$ "
" D to E $\frac{5}{16}$ "
" E to F $\frac{1}{4}$ "

Dimensions of **L** irons, **G**; angle irons, **H**; and stiffening-plates, **I**.
L irons marked **G** are 3 × 3 × $\frac{3}{8}$ in. thick.
L do. do. **G′** are 4 × 4 × $\frac{3}{8}$ in.; the lower two 4 × 4 × $\frac{1}{2}$ in.
Angle irons marked **H** are 3 × 3 × $\frac{3}{8}$ in.
Do. do. **′H** are $3\frac{1}{2}$ × $3\frac{1}{2}$ × $\frac{3}{8}$ in.
I stiffening-plates, the four on the inner skin 10 × $\frac{1}{2}$ in. thiek.
I do. do. outer skin 12 × $\frac{1}{2}$ and 15 × $\frac{1}{2}$ in. thick
J T irons $7\frac{1}{2}$ × 4 × $\frac{1}{2}$ in. thick.

PUMPING-ENGINE AT CROYDON.

Plate lxxix. exhibits two views of a pair of high-pressure horizontal Pumping Engines, designed by Mr. J. C. Craven, locomotive super-intendent to the London, Brighton, and South Coast Railway. They were made in the workshops at Brighton belonging to the Company, and were originally intended solely for the purpose of draining a portion of land, to enable the ballast to be got out from the pits for the purpose of ballasting the line.

The water, which is of excellent quality, poured in upon the works in immense quantities, and was found to be of great inconvenience, until the idea suggested itself to the Company's engineer that it might be advantageously employed along the line, more especially at the loco-motive depôt and workshops at New Cross, for supplying the locomotive and other engines with water.

Accordingly, this engine and pumps were designed, eonstrueted, and erected for the purpose, and they answer admirably.

The want of a sufficiently large reservoir to contain a supply of water at a suitable elevation to command the whole of the stations, and points of service along the line, and wherein might be stored a suf-ficiently large quantity to provide against the accidental breaking down of engines, pumps or gear, was readily met by the Crystal Palace Com-pany consenting to allow the Railway Company to pump into one of their large reservoirs. Thus the railway people are enabled to draw at all times as much water as may be required, at a suitable pressure, and without any of the waste or loss of water which would otherwise take place from the constant and large quantity constantly draining into the ballast pits night and day; it will be seen, by the result of twelve hours' working per day, the level in the well is rarely reduced to an extent of more than 9 in.

There is nothing particularly novel or original in the engines, or in the arrangement of the engines and pumps, but they are excellent speeimens of workmanship, and are well-proportioned and efficient machines.

They consist of a pair of locomotive cylinders and gear, placed hori-zontally on a bed-plate at a convenient height, so as to be perfeetly under command; the dimensions and partieulars of the parts are here-after given.

The eonnecting-rods of these engines work two half-cranks placed at a right angle with each other upon a short shaft, carrying two fly-wheels and a spur pinion, into which latter is joined a spur-wheel of a propor-tion of seventy-four to twenty-two, by which the number of strokes of the pumps is much reduced; the length of the stroke of the pumps being, however, double that of the engines.

The plunger-rods project through the stuffing-boxes in the cover, on the back end of each pump, and they are well guarded at three points, as, in addition to the glands in the two covers, a cross-head takes the end of the plunger-rod and travels upon two round guide-bars; thus the wear is reduced in the barrel of the pump, the plunger packings have a better chance, and the rods cannot be bent or strained.

The whole of the cylinders, guide-blocks, crank-shaft, plummer-blocks, pumps, &c., being securely bolted to one continuous cast-iron sole-plate, the engines and pumps work, when at full speed, smoothly, and without the least jar or vibration.

We will now proceed to describe the accompanying Plate, No. lxxix.:—

Fig. 1 is a longitudinal elevation of the engine, air-vessel, and founda-tion, and exhibiting a section of one pump. Fig. 2 is a plan of the same, but the engine, together with the pump and gear, are shown in section, and the delivery-pipe, chamber, and valve-boxes are entirely removed. The engine consists of two cylinders, working side by side, connected to one crank-shaft, upon which are two fly-wheels, and a pinion between them, working into a large wheel on the shaft, which communieate motion to the pumps by means of two outside cranks.

The cylinders are 15-in. diameter, 24 in. stroke, and work at seventy-four single strokes per minute.

The pumps are double-acting, 8 in. diameter, with a stroke of 4 ft., and make twenty-two strokes per minute. The plunger, pitchings, and valves are all of vulcanised India rubber, for vulcanised India rubber possesses one great advantage over the ordinary leathers used in double-acting pumps, which is, the facility with which they can be tightened up without disturbing the pump covers. The guide-rods passing through the back end of the pumps are screwed on to the pump-rod with a socket-end, the India rubber being enclosed betwixt two brass washers, can, by turning the aforesaid guide-rod, be tightened or other-wise adjusted as required: this is found to answer exceedingly well, as in this and other similar cases a great quantity of gritty matter is con-stantly passing through the pumps which, with the ordinary applica-tion, would soon destroy the leather, and also injure the barrels, whilst by this method of substituting India rubber for leather, it is entirely obviated. The India rubber paekings have now been at work night and day upwards of eight months, and are very little the worse for wear whilst the duration of the leather never exceeded six weeks.

The pumps discharged themselves into an air-vessel, which is con-neeted with a stand-pipe, built for eonvenience inside the engine-chimney. The suction and delivery valves (an illustration of one being shown by Fig. 1) are of the disc form, of India rubber, placed over perforated plates, the openings of which exceed the area of the pump-barrel; these have been found to work well, and without the usual noise and vibration attending metal valves; and also possess the advantage of keeping tight without frequent adjustment.

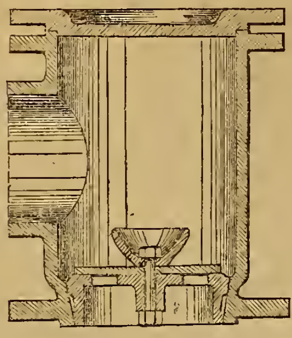


Fig. 1.

Adjoining the engine-room are two circular boilers, which are worked alternately. They are fixed inside the flues, which are connected with side flues built round each, so that the heat must pass round the sides before escaping into the chimney. The feed water is supplied from a closed cistern through a coil of pipes placed in it, the exhaust steam is thrown into the cistern, and a temperature of 200° is constantly maintained, by which a considerable saving of fuel is effected.

The following statement shows the result of one day's working of the engines (commenced pumping at 6 A.M., stopped pumping at 6 P.M.):—

Hours of Observation.	Level of Water on Well Gauge.	Average Strokes of Pumps per Minute.	Pressure at Air Vessel in feet.	Pressure in lbs.	Remarks.
	ft. in.	No.	ft.	lbs.	
6 A.M.	4 9	22	90	39	
8 A.M.	4 10½	..	..	..	6 barrows of coal, each of 2 cwt.
10 A.M.	5 0	..	..	..	
12 NOON........	5 1½	..	..	..	
2 P.M.	5 3	..	..	..	
4 P.M.	5 4½	..	..	..	
6 P.M.	5 6	..	..	..	

The above is the average of the performances of these engines and pumps.

We must, for want of space, defer until our next Number the further particulars of the work performed by the engines, the dimensions of the boilers, sizes and lengths of delivery-pipes, actual quantity of water delivered, &c.

PUMPS AND PUMPING MACHINERY.

We have recently published several Papers upon pumping-engines, which have been illustrated by plates. We have noticed from time to time several descriptions of pumps,—the pumping-engines and machinery for draining the Haarlem Mere, and the history of the progress of that great work, has been discussed and given at length in a series of papers, which are concluded in the present Number;—we describe and illustrate in the present Number the pumping-engine at Croydon, which was set up for keeping dry the ballast-pit belonging to the Brighton Railway Company, and which now supplies a large quantity of water to the Crystal Palace Company, in addition to supplying the New Cross locomotive depôt and shops;—the comparative performances of the Appold-pump, as improved by Easton and Amos, and the Gwynne-pump, as exhibited at the Crystal Palace, we intend shortly to give, together with some further illustrations of pumping machinery. These will, we trust, satisfy our readers, and also fully answer numerous Correspondents, to some of whom we have replied at various times through our "Notices to Correspondents." With this object in view, we at the present time intend only to make reference to the disc-pump, as a form of hydraulic machine not sufficiently well known.

We have upon previous occasions described the disc-engine of Davies and Bishopp, and its construction is now pretty generally understood; and the disc-pump is neither more nor less than the disc-engine of Davies and Bishopp transferred into a machine for raising water, with this difference, that while the disc-engine requires great accuracy of workmanship to prevent the escape of steam, the disc-pump requires no greater accuracy than that its interior rolling and rubbing surfaces shall merely come in contact; all that is required being, that it shall merely make sufficient vacuum in its oscillatory motion to cause the water to rise up the suction-pipe, and that, on its entering into the body of the pump, the water may be forced above the disc; it is, in fact, a suction and force-pump combined.

It was originally patented for a pump, and an excellent pump it has proved to be, as is testified by the several pumps worked by disc-engines, which have been erected in various parts of the country. In illustration of this we may mention that a disc-pump of 57 in. diameter, and worked by a small disc-engine, was erected for Mr. Marshall, of Leeds, on his estate in Holderness, Yorkshire, where it has been very successfully employed in draining marsh lands for some years; and so satisfied was that gentleman with its performance, that he had another made and attached to the disc-engine which had been constructed by Messrs. Rennie and Co. in 1851, for his works at Hanwood, near Shrewsbury. The disc-pump in question is 16 in. diameter, and the following extract of a letter from Mr. William Smith, the manager of the works, will show the performance of the pump referred to. He says, with reference to the work done by it, under an accurate test made by him:—

"According to the data furnished to me by Mr. Bishopp, her theoretical discharge, at seventy-five revolutions per minute, should be 11,250 gallons per hour. The following is the result of a fifteen minutes' experiment, having had her running some time, so as to have all the pipes full of water:—In fifteen minutes, at seventy-five revolutions per minute, she filled the tank over the engine-house 14 in. in depth. The tank is 27 ft. 6 in. long, and 13 ft. 8 in. wide. This will give 438·5 cubic ft. in fifteen minutes, or 10,962 gallons per hour as the actual discharge, being a difference of only 2½ per cent. between the actual and theoretical discharge. This is a very satisfactory experiment, and I hope she will continue to act as well as she commenced."

We also remember to have seen a disc-pump of 8 in. diameter driven by a 13-in. disc-engine, which was employed as a donkey engine in the General Screw Steam Company's late ship *Crœsus*, and one also in the Peninsular and Oriental Steam Navigation Company's steam-ship *Candia*, for furnishing the great boilers of those vessels with water, and occasionally for clearing the bilge-water from the holds; and their performances have also been highly satisfactory.

The great advantage of a disc-pump is, that it may be driven at velocities that no reciprocating pumps can approach; 250, and even 300 revolutions per minute, are not uncommon speeds for a 13-in. disc-pump, each revolution giving 318 cubic in., or upwards of a gallon of water for each revolution.

For the present we must defer anything further upon this subject.

DESCRIPTION OF THE DRAINAGE OF THE HAARLEM MERE.

(Continued from page 149.)

The principal condition of the contract with the district was, that in summer the level of the *boezem* should not be raised more than 17 centim. (6⅞ in.) above M.L., while in the winter 15 centim. more, or 32 centim. (12½ in.), were allowed. These conditions have, to a great extent, increased the duration of the work, and, accordingly, the expense of the drainage, while they necessitated the constant stopping of the engines, when the prescribed level was attained. In the mean while, the enclosure of the lake was finished, and two other engines were constructed of the same power and arrangement as the *Leeghwater*, with some few modifications, which have been indicated above. One of the two is placed on the spot where the river *Spaarne* unites with the intercepting canal, the greatest quantity of water raised by it being conducted to *Spaarndam*, where it is discharged into the Y. It is called the *Cruquius*, after the name of a man who, in the year 1742, made a skilful plan for draining the mere, while the other is placed on the north side, in the vicinity of the sluices at *Halfweg*. It is called the *Lynden*, in honour of Van Lynden van Hemmen, Bart., who in 1822 published an excellent treatise on the drainage of the mere, but did not live to see the realisation of his cherished idea. Both these engines are indicated on the map by their respective names. The building of the *Cruquius* was contracted for, for a sum of 220,665 fl., but to this sum are to be added 10,000 fl. for the unusual difficulties encountered in laying the foundations, which were of such a nature that the contractor had nearly given up the work, so that the total cost has been 230,665 fl. (£19,222). The soil, at the depth required for the foundation, was of such a nature that the utmost energy and nicety of skill were required to overcome the almost insurmountable difficulties. It consisted of a layer of shale through which water and sand percolated with such force that a portable steam-engine of 10 H.P., and three other machines for raising water, moved by sixty horses,* were not capable to discharge the water and sand at the same rate as it entered at the bottom. At the same time, the sides of the pit were forced out by the superincumbent weight, so that another mode of working had to be adopted, or the work given up. Therefore, to prevent the sides of the pit from slipping, heavy deals were driven in the bottom, close against them, one near the other, forming, as it were, an immense tub, so that the water could not enter then through the bottom, whence it was duly discharged by the addition of a fourth machine, so that a power of no less than eighty-four horses, besides the steam-engine, were night and day at work to raise the water, which entered continuously with great force. During this time, no less than 1,700 piles had to be driven in the bottom of the pit, and a wooden platform laid on their tops; this work had to be carried on with the greatest possible despatch, no less than 450 men being at work in the pit at the same time. In this manner art has triumphed over the obstacles, so that the building has been elevated on a firm and secure foundation. The other building presented no difficulties whatever, and was erected for a sum of 218,528 fl. (£18,210).

The two engines, with the levers and boilers, were contracted for by the same firms which had constructed the *Leeghwater*, for a price of 639,423 fl. (£53,285). They were to be finished in August, 1848, but from various circumstances it was not before the beginning of 1849 that they could be set at work.

In the mean while the drainage of the mere was commenced by the *Leeghwater* alone, which had been set in action, discharging the water from the lake, on the 7th of June of the preceding year, the level of the mere being at that time 0·13 met. (5 in.) below M.L. The *Cruquius* commenced pumping on the 1st of April, 1849, the *Lynden* eighteen days afterwards. The first engine had lowered the level of the mere during the time of its working 0·14 met. ($5\frac{1}{2}$ in.) At this time the drainage may be reckoned to have commenced, it being finished in July, 1852, occupying thirty-nine months, a greater time than was calculated, but which is explained by the following statement :—

The three engines made, during this space of time, together, 14,004,032 strokes,† discharging (deducting $\frac{1}{10}$th for leakage), 831,839,501 cubic met. (817,712,236 tons) of water. At the commencement of the drainage the depth of water in the lake was 3·21 met. (10 ft. 5 in.), which, with an area of 18,100 hectares, gives a cubical content of 581,010,000 cubic met. The rain which fell during this period has, according to very careful observations, been in excess of the evaporation by the trifling quantity of 0·0202 met. (0·7753 in.), giving for the surface of the lake 3,656,200 cubic met., so that the total quantity of water in the mere, added to the falling rain water, amounted to 584,666,200 cubic met., falling short by 247,173,301 cubic met. (244,253,745 tons) of the calculated quantity pumped out. This difference may be partly ascribed to leakage, which undoubtedly on many occasions has been greater than $\frac{1}{10}$th of the quantity raised, and partly to the strokes not always being full; but these causes cannot answer for the great difference which must for the most part be ascribed to filtration through the bottom and sides. This filtration, which is met with in all similar drainage works, but in this instance in a rather greater proportion than usual, goes on decreasing afterwards, when the newly-laid embankments are thoroughly dried and settled, but never disappears totally. It depends on the greater or less porosity of the soil, which, especially on the north-west side, in the vicinity of the river *Spaarne*, is of a very light and porous nature. Heavy repairs were required, which, on an average, caused a delay for each engine of three months, the inadvertency of an engine-driver causing the breaking down of three of the heavy levers at the *Leeghwater*, while, by some unknown cause at the *Cruquius*, the ears of the great cap for the guide-rods were broken off. The buckets and foot-valves required many repairs, caused principally by the great quantity of mud collecting on the platform on which they stand, so that it had to be cleared many times, for which purpose the building had to be isolated from the mere by dams. But the greatest delay was caused by the regulations of *Rhynland*, requiring the engines to stop, when the level of the *boezem* was raised to a certain height.

By these combined causes, the engines were in full work but half of the time during the drainage—viz., nineteen months and a half. The water pumped out exceeded the quantity expected (which was, as before stated, 766,000,000 of cub. met.), by nearly 66,000,000 cub. met., requiring one month and a half to be pumped out, increasing the calculated time to fifteen months and a half, leaving out a difference of four months, which is to be ascribed to the speed at which the engines were worked being less than was calculated, this being considered necessary for safety. Even assuming the very improbable circumstance, that the filtration will not decrease, the calculations show that under the most unfavourable circumstances, the engines are capable of removing the greatest possible quantity of water that may collect in a month, which has been proved by the experience acquired during the three years the lake has been dry.

In the preliminary plan it had been fixed that a fourth sluice-gate should be added, to the three existing at *Halfweg*, for giving the water a better discharge at that point. The Commissioners, however, had delayed the execution of this work, so as to watch and be able to judge correctly of the action of the steam-engine at *Spaarndam* on the *boezem*, as also the influence of the enclosure of the mere, on the affluence of the water to these sluices, the water being now conducted only from the two sides of the canal. This experience showed that the existing sluices were more than sufficient to discharge the water in the direction indicated, but they saw the desirableness of erecting another steam-engine. Accordingly the placing of a steam-engine, after the manner of that at *Spaarndam* was resolved upon, but pecuniary difficulties delayed the execution of this plan until the year 1850. For this engine one of the existing sluice gates has been utilised in such a manner, that when natural discharge takes place this sluice works as before, while, when needed, the water is discharged through it by the steam-engine. This engine has a nominal power of 100 horses, being condensing and expansive, the steam pressure being three atmospheres. The cylinder is horizontal, diameter, 1,016 met. (40 in.); stroke, 2·44 met. (8 ft.) On each side of the engine are three flash-wheels, having a diameter of 6·60 (21 ft. 8 in.), and a breadth of 2 met. (6 ft. $6\frac{3}{4}$ in.), lying at such a height, that they can even work at spring tides. Their axles are not, as at *Spaarndam*, in a line with the crank-axle of the engine, but are moved by spur-wheels and pinions in such a proportion that as the engine makes $13\frac{1}{2}$ revolutions per minute (its normal speed) the wheels make 6 revolutions. The axles of the wheels are furnished with coupling-boxes, so that according to a greater or less difference of level, one or more of the wheels may be coupled. To supply steam to this engine there are three cylindrical boilers with internal flues. Diameter of boilers, 1·68 met. (5 ft. 6 in.); diameter of flues, 1·02 met. (3 ft. 4 in.); length, 8·53 met. (28 ft.) Above and across these boilers

* The machines generally made use of in Holland for draining deep foundations are a sort of noria, consisting of a square wooden trunk lying at an angle, it being open at both ends; the bottom end enters the water and the top is laid at the level to which the water has to be raised. An endless chain, passing over rollers, at the top and bottom of the trunk, passes through it, being provided at short distances with square boards, fitting nearly in the trunk. The upper roller being moved by horse-gear, the water contained between each pair of boards is conveyed to the required height and discharged at the top.

† This number of strokes is reduced to the total number of pumps.

is placed a steam-chest, having a length of 6·40 met. (21 ft.), and a diameter of 1·22 met. (4 ft.)

The engine should have been finished in June, 1852, but was not ready until 1853, so that it was not worked until after the drainage of the mere was finished. It has, however, since done good service in discharging the water from the *boezem* of Rhynland. Had it been erected in 1848, it would have contributed much to shorten the time of the drainage. It was constructed by Messrs. Paul van Vlissingen and Dudok van Heel at Amsterdam, for a sum of 79,924 fl. (£6,660), while the building was erected for a sum of 94,762 fl. (£7,897).

During the drainage of the mere, no unusual wet years occurred; for had such been the case, the engines must have been stopped for a much longer time, in order not to raise the level of the *boezem* of Rhynland too much, which during this time discharged its superfluous water on the points before named. But now, after the drainage, the same necessity for a good discharge exists, and much more than before, for while formerly the superfluous water of 70,000 hectares (173,000 acres) was received on a *boezem*, having an area of 22,700 hectares (54,538 acres), the superfluous water of 88,000 hectares (217,460 acres), has to be received on a *boezem* of which the area is but 5,000 hectares (12,356 acres), so that its level is raised in a much shorter time. Therefore, the existing means were considered insufficient to meet unfavourable circumstances, and a sum of 200,000 fl. (£16,600), was allowed for the erection of a third steam-engine, equal to that at *Halfweg*, for the discharge of the *boezem*. This engine, which at this very moment is in course of construction, is intended to be placed at *Gouda*, to bring the water on the river *Yssel*. With the aid of these powerful means, there is not the least danger of the district of *Rhynland* being overflowed, for except by the three steam-engines, the water is discharged at Katwyk, on the North Sea. The great value of the engines for discharging the *boezem* may be shown by the statement that during the year 1854, and the first four months of the following year, the engine at *Spaarndam* has raised about 184,000,000 cubic met.; and that at *Halfweg*, in the same time, about 107,000,000, making together a volume of 291,000,000 cubic met. (304,000,000 of tons.) Three great pumping engines have drawn from the mere, which after the drainage is called *polder*, since the 1st July, 1852, unto the 1st May, 1855, 398,000,000 cubic met., being at the rate of 140,000,000 yearly, or 7,700 cubic met. per hectare, corresponding with 3,067 tons per acre. This gives a height of 0·77 met., rather more than 30 inches for rain and filtration water, which is considerably more than that found by Mr. Glynn, viz.—24 in. giving 7,260 cubic ft. per acre and per month, while this height gives 9,166 cubic ft. It must, however, not be overlooked, that this quantity will decrease after some years, but the nature of the soil is such that a considerable quantity of water will always percolate through it.

The mere being dry, it remained to be divided, and suitable drains, roads, and bridges had to be constructed. It was a point of consideration to fix the area of each piece enclosed by drains, so that it should not be too small, whereby too much valuable ground was occupied by the drains, and, at the same time, not too great, whereby the drainage might be imperfect. In the earlier drainages by windmills, the collective area of the catch-water drains occupied an area of $\frac{1}{10}$ — $\frac{1}{12}$ of the whole surface; but in the case of land drained by steam power so great an area is not required, while the drains have not to retain the water until the blowing of a favourable wind, but can be discharged at the rate of their being filled. It was accordingly resolved to divide the land in pieces, surrounded by drains of an area of 20 hectares (49·4 acres), having a length of 1,000 met. (1,060 yards), and a breadth of 200 met. (212 yards), and lying in the direction from north-west to south-east. By this division but $\frac{1}{32}$ of the whole area is occupied by the drains, the principal canal or drain having a width of 25 met. (82 ft.), runs in nearly a straight line from the *Leeghwater* to the *Lynden* engine, having a length of about 20½ kilomet. (12⅝ miles), while another drain of the same dimensions, perpendicular on it, conveys the water to the *Cruquius*. Three drains of smaller dimensions—their width being but 8 met. (26¼ ft.)—run parallel to, and on each side of, this main drain, being crossed by six similar drains, whereby the land is divided into squares, which again being divided longitudinally by roads in two parts, form areas of 300 hectares (741 acres), which by the minor drains are again subdivided in fifteen pieces of 20 hectares, as indicated above. The drains are indicated on the map by straight, thicker or thinner lines—the roads by two parallel lines (=). Except the small drains, dividing the squares formed by the main drains, about 180 kilomet. (112 miles) of drains, nearly 200 kilom. of road and about sixty-five bridges have been constructed, of which twelve are over the principal main drain. These works have been executed for a sum of 1,261,199 fl. (£105,099). After this was accomplished, the ground had to be sold, which was done in the three consecutive years, 1853, 1854, and 1855. These sales have produced much more than was expected, 16,822 hectares having been sold for 7,972,400 fl., or on an average at the price of 473 fl. per hectare (£16 2*s.* 8*d.* per acre). An area of 32 hectares (79 acres) has been reserved for the building of villages, after a fixed plan, this area being valued at a sum of 7,000 fl. (£583). The quality of the land is not the same in all places, some tracts being of the first, and others of an average quality; but on an average it is good. For the most part rape seed is cultivated, it being the best crop for newly-drained grounds. The crops of 1855 have been excellent, as well as regards quality as quantity.

To complete this description, it only remains to give a review of the total expense. For the drainage was borrowed a capital of 9,916,344 fl. (£826,362) nominally, but which amounted to no more than 8,429,344 fl. effective, to which were added afterwards, at different periods 552,000 fl., so that the total allowed sums amounted to 8,981,344 fl. (£748,445).

The following table gives the amount of the expenses from 1839 until the end of 1855:—

	Florins.		£
1. Works for improving the discharge of the *boezem* of Rhynland—viz., the widening of the canal and sluice-gate of *Katwyk*, the improvement of the *Spaarne*, the erecting of the steam-engines at *Spaarndam* and at *Halfweg*, with that in course of construction at Gouda, calculated at 200,000 fl. .	1,289,167	=	107,430
2. Enclosure, embankment, and canal.	1,988,257	=	165,689
3. Expropriation	684,514	=	57,042
4. The three steam-engines for the drainage of the lake, with the cost of repairs, coals, and wages, until December, 1855	2,299,523	=	191,627
5. Works in behalf of the navigation—viz., the towing-path along the *Spaarne* and the enclosure canal, with the bridges, improvements of some existing canals, &c..	133,288	=	11,107
6. Works for the defence of the capital by inundation. .	275,921	=	22,993
7. Works relative to the division of the grounds—viz., the construction of drains, roads, bridges, &c..	1,261,199	=	105,100
8. Entertaining and repairs of the different works during the drainage, until the end of 1855.	363,751	=	30,314
9. Direction, office expenses, policy, experiments, &c.	639,477	=	53,289
10. Expenses not provided for.	46,247	=	3,854
Whereto are to be added 220,000 fl., which were expended for repairing the drains and enclosure of canal, which, in the winter, from 1854-55, had suffered considerably by the banks not then being thoroughly settled, and being soaked the alternate frost and damp weather caused a slipping and filling of the drains and canals.	220,000	=	18,333
	9,201,344	=	766,778

The profits may be calculated as follow:—

	Florins.		£
Sale of the grounds.	7,972,400	=	664,366
Profits of a fund formed by utilising the money not directly required, and the profits of the grass on the banks being sold until 1853.	932,236	=	77,686
Profits of the grass during 1854, as also from the taxes for keeping the land dry, amounting to 7 fl. per hectare (4*s.* 8*d.* per acre)	61,647	=	5,137
The same for 1855.	87,461	=	7,288
Profits from the sale of 32 hectares for building villages, valued at.	70,000	=	5,833
Profits of 42 hectares, near the engine the *Cruquius*, valued at.	14,700	=	1,225
	9,138,444	=	761,535

This difference between outlay and profits is very trifling, but to it must be added the rent of the first negotiated capital, amounting together to about three and half million florins (£29,000); so that the total cost for which the Haarlem Mere has been drained, with all the additional works enumerated above, and their repairs, together with the discharging of the superfluous water, during three consecutive years, notwithstanding the drainage has lasted much longer than was expected, has been performed for this comparatively small sum. This sum will be diminished afterwards, when the lands, which, during the first twenty years are free, begin to pay taxes.

Thus, by this extraordinary work—which may be considered as being the greatest of the kind ever performed—a surface of water, which every year invaded a greater portion of its banks, and grew every year more dangerous for the great and rich towns which are situated in its vicinity, has been transformed into valuable crop-growing land, which every year improves in quality and gradually realizes a higher price; so that whilst 18,000 hectares more are now cultivated in the richest part of the Netherlands, adding so much more to the public wealth, a permanent barrier has been formed against the encroachments of the North Sea upon an enormous tract of lowlands situated between the North Sea and the Zuider Zee. It is attributable to the uncommon skill and energy of the engineers and the Commissioners that this work has been finished with such a success, and they have given to the world an example of what may be done in this way, and how it may be performed in a comparatively short time with but a small amount of capital when judiciously expended. The drainage of the Haarlem Mere is a triumph of science over nature, of which Holland may for ever be proud.

H. C. Bosscha, C.E.

Deventer, Holland, February 1856.

PERFORMANCES OF THE SCREW STEAMER, "LE LYONNAIS."

In our last Number we gave a description of a vessel called the *Alma* belonging to the Franco-American Company, which runs first-class, screw steamers from Havre to New York, and from Havre to Pernambuco and Rio Janeiro, by way of Goree.

The *Alma* is on the New York line. *Le Lyonnais* and *Cadiz* run to Rio. The company have, in all, about eight steamers; and, from the foreign mode of living on board, and their going direct to Havre, appear to be serious competitors to the West India Mail Company for continental passengers from Rio Janeiro and the Brazils.

The tonnage and construction of *Le Lyonnais* and *Cadiz* are similar to that of the *Alma*, but the power of each of the former is 100 H.P. less than the latter.

Notwithstanding this difference in nominal power, the speed is considerably greater; for whereas, by the reports we have received, the *Alma* steams but ten knots, *Le Lyonnais* and *Cadiz* easily compass eleven by fair steaming through the water.

Annexed is a rough log of the steaming qualities of *Le Lyonnais*, as taken by the engineer on her first voyage; but now that the engines have worked for one voyage, the next voyage will no doubt give a still better result. It should be remarked that head winds impeded the progress of the ship on the homeward voyage.

The engines of *Le Lyonnais* and *Cadiz* were designed and constructed by Messrs. G. Rennie and Sons, and are excellent specimens of mechanical construction; they are similar, but of greater power, than those of the *Conte de Cavour*, Sardinian steamer, which lately arrived in the Thames from the Mediterranean, to refit cabins, after upwards of a year's employment in the French Government transport service; at the expiration of which time, not only do the engines require no repair, but they are in more perfect working order than when we saw them at work at the time of her trial trip. By the way, we learn it is the intention of the proprietors of the *Conte de Cavour* that this vessel is to be the pioneer of the Transatlantic line from Genoa.

The engines of *Le Lyonnais* are on Messrs. Rennie's patent horizontal direct action trunk principle, and are of the following dimensions:—

	Ft.	In.
Effective diameter of cylinder	0	56
Stroke	2	6
Pitch of screw	23	0
Diameter of do.	16	6
Number of revolutions	60	

The boilers give plenty of steam on all occasions, are perfectly tight, and easily fired.

The following is the log above referred to:—

ABSTRACT OF THE PERFORMANCE OF STEAM-SHIP "LE LYONNAIS" FROM RIO JANEIRO TO HAVRE, JUNE, 1856.

	Draught of Water.		Steam Pressure in lbs.	Vacuum in Inches Mercury.	Revolutions per minute.	Knots per hour.	Wind.	Sails set.	Seaway.	Remarks.
	Forward.	Aft.								
May 18	18ft.	18ft.	24	2	44	8·25	Brisk gale ahead....	...	Long and heavy.	
May 19	..	..	9	..	39	6	Easier ahead.	...	Easier.	
May 20	..	..	5	..	34	6	Strong breeze ahead.	Jib.		
May 21	..	..	14	..	50	..	Fresh breeze.	All plain sail ...	Moderate.	
May 22	17ft. 6in.	18ft. 3in.	9	..	47½	10	Fresh breeze.	All plain sail.		
May 23	..	..	12	..	44	7·4	Fresh breeze.	Jib.		Since leaving Rio de Janerio to 1st June, steam-pressure has ranged from 5lbs. to 14lbs., the mean being 9lbs., arising from inferior coals and stoker.
May 24	..	..	13	..	48	10·5	Strong breeze.......	All plain sail.		
May 25	..	..	14	23	43	7	Strong breeze ahead.	...	Heavy.	
May 26	..	..	9	..	47	9	Fine breeze.........	All plain, less top gallant sails...	Easy.	
May 27	..	..	11	..	50	10·9	Fine breeze.........	All plain, and two studding sails.		
May 28	..	..	12	23½	49	11	Fine breeze.........	All plain, close hauled.		
May 30	..	..	15	..	49	8·5	Light breeze ahead.	...	None.	
June 1	15ft. 3in.	17ft.	12	.. ¶	45½	9·2	Calm..............	...	Moderate.	
June 4	..	..	14	..	46	8·5	Strong breeze ahead.	...	Moderate.	
June 4	..	..	16	..	52½	9·2	Fine breeze ahead...	Fore and aft canvass.		
June 8	..	..	14	24	50	9·2	Fresh breeze ahead..			
June 9	..	..	14	23½ 17½	46½	7·5	Strong breeze ahead.	...	Pitching.	
June 10	..	..	15	24	51½	9·8	Fresh breeze ahead..	...	None.	
June 11	..	..	13	..	50	8·8	Fresh breeze ahead..	...	None.	
June 14	17ft.	17ft. 6in.	13	23½	48	9·2	Fine breeze ahead...	...	Easy.	
June 15	..	..	15	24	52	9·2	Light breeze ahead.	...	Long swell.	
June 16	..	..	14½	24½	55	11·7	Fine breeze ahead...	All plain, less top gallant sails.	None.	
June 17	..	..	14	24½	54	11	None.	None. ...	None.	

Notes of Voyage from Havre to Rio Janeiro.

Coals expended in engine-room	956 tons 16 cwt.
" " cooking	13 " 4 "
Total expenditure	970 " 0 "
Coals per day in engine-room	42 " 0 "
" per mile	3 cwt. 2 qrs. 8 lbs.
" expended without progress, half a day, at 42 tons per day	21 tons.
" remaining on arrival at Rio Janeiro	170 "
Under steam waiting to start. 1-5th of active consumption.	
Hours, active progress, Havre to Rio Janeiro	532 or 22 days 4 hrs.
" steam up	590½ " 24 " 14½ "
" detention in ports	106 " 4 " 10 "
" stoppages	34 " 1 " 10 "
Average miles per day	236
" " hour	9·83
" " day after leaving Lisbon	245½
" " hour " "	10·22

Notes of Voyage from Rio Janeiro to Havre.

Coals expended in engine-room	1162·12 tons.
" " cooking	18·8 "
Total expenditure	1,181 "
Coals expended per mile	4 cwt. 1 qr. 15 lbs.
" " without progress	14 "
" remaining on arrival at Havre	190 "
Hours, active progress, Rio Janeiro to Havre	637 or 26 days 13 hrs.
" steam	675¾ " 28 " 3 hrs.
" detention in ports and approaching them	86¼
" stoppages	
Average miles per day	197¾
" " hour	8¼
Coals per day	43 tons 7 cwt.
Hours at sea	646
Rio Janeiro to Havre Roads	30 days 13½ hours.

We believe the above to be very creditable performances, and that they will, under similar circumstances, bear comparison with the very best of those which have come under our notice.

It is also pleasing to observe that some engineering firms are now adopting the excellent practice of invariably sending a really competent person on the first voyage out and home, in charge of new engines and machinery, with instructions to note *every* particular connected with the working of the machinery, consumption of fuel, &c. In the above instance the person in charge of *Le Lyonnais* has carefully noted every circumstance connected with the voyage.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(FROM OUR OWN CORRESPONDENT.)

Southampton, July 23rd, 1856.

The event of the month most interesting our port is the decision of the Government that the Australian Mail, lately contracted for, shall start from, and arrive here. We think that a brief account of the various efforts that have been made to establish steam communication between this country and her important Tasmanian Colonies, will be both interesting and useful to the readers of The Artizan.

The route selected by the Australian Royal Mail Company in 1852, was from Plymouth to the Cape of Good Hope, and thence to Melbourne and Sydney — a distance of 13,367 miles, and their vessels were the *Sydney*, *Australian*, *Melbourne*, *Adelaide*, and *Victoria*—the first three being about 1,600 tons burthen, and 300 H.P., and the two latter vessels about 2,000 tons and 450 H.P.

This company were signally unfortunate in their voyages, with the single exception of one vessel, the *Victoria*, which made a passage out in 64 days, and homewards, by Cape Horn, in 84 days. Their failure was, in a great degree, owing to the enormous consumption of fuel which so long a voyage requires with full powered steamers, necessitating frequent stoppages at coaling stations; and the delays so caused (which in many cases were much increased from faulty arrangements in supplying the coaling depôts) protracted the voyages to 80, and sometimes 100, and even 130 days.

This Company, therefore, gave up the mail contract, and the next in order were the General Screw Company, with their fine fleet of steamers, such as the *Queen of the South*, *Lady Jocelyn*, *Indiana*, &c.,—vessels of about 1,800 tons, and 300 H.P. This was a bi-monthly contract; the mail of the intermediate month being carried by the Peninsular and Oriental Company, *viâ* Suez.

The passages made by the General Screw Company's vessels were certainly an improvement on the earlier efforts of their predecessors, and their arrangements generally were better carried out—their vessels were fitted with feathering and hoisting propellers, and consequently a considerable portion of the voyage was performed under sail alone; but still the consumption of coal was very heavy, and a source of great delay, so that, both commercially and practically, this undertaking was a second failure in steam communication with Australia. These vessels have since been better employed in the transport service.

The Australian Mail carried by the Peninsular and Oriental Company was, during its continuance, much more efficaciously and regularly performed.

It started with the East Indian Mails, carried by this Company from Southampton, thence to Malta and Alexandria, across Egypt to Suez, where they were re-shipped in one of the Company's steamers, which proceeded to Point de Galle, in the island of Ceylon. The Australian Mail was then transhipped into another steamer, which proceeded direct to Melbourne and Sydney.

The distance by this route is 11,521 miles, or 1,846 miles less than that, *viâ* the Cape of Good Hope, and the time occupied averaged 64 days; in one instance, we believe, it was performed in 57½ days.

The demand for transport steamers, however, during the late war, was so urgent, that the Peninsular and Oriental Company were compelled to withdraw their vessels from this line in November, 1854, to the great chagrin and disappointment of the Colonies, and of all interested in colonial affairs in this country.

Since this period the mail service has been performed by sailing vessels, *viâ* the Cape of Good Hope, outwards, and generally Cape Horn, homewards. Their time has varied from 75 days outwards, and 83 days home, to 108 days out, and 105 days home—an average of ten voyages each way, giving a mean time of 84½ days out and 93½ days home.

This long interval of time required by merchants to obtain answers to their letters, naturally inspired the colonists with feelings of impatience, and caused frequent remonstrances with the home authorities, and led to an association, formed in London, and consisting of many influential gentlemen connected with Australian enterprise, who, in March of the present year, memorialised the Government, praying them "to invite tenders for the immediate establishment of a regular and reliable monthly postal steam communication with Australia."

They also suggested to the Government a route different to any previously attempted—viz., that the mail on its arrival at Suez should be placed on board a steamer, which should proceed direct to the Island of Diego Garcia, or Great Chagos Island (which would form a coaling station), and thence direct to Melbourne. The distance from London to Melbourne, by this route, they call 10,348 miles, that part of it between London and Marseilles being *viâ* Dover and Paris. So that, if this be correct, which there is no reason to doubt, there would be a saving of 1,173 miles by its adoption.

The invitations of the Government for tenders were issued in May and June, and, after considerable negociations had been entered into, a contract was taken by a new company, called the European and Australian Company, for the service.

The route selected is from Suez, *viâ* Point de Galle and Cape Lewin, to Melbourne; the time outwards forty-five days, and homewards forty-three days; penalties of £50 per day (increasing arithmetically, we believe) for each day beyond the time mentioned, and, it is said, a bonus of £30 for each day within the time guaranteed.

The subsidy is £185,000 per annum, half of which has to be disbursed by the Colonial and half by the Home Governments.

The first vessel of the Company is to be ready for survey on the 1st of August; she will, if approved of, leave with a mail, *viâ* the Cape, to Melbourne; others will follow every month, and it is expected that on the 1st January, 1857, the whole arrangements will be complete. This Company has undertaken to run steamers from Southampton to Alexandria, and from Suez to Melbourne, so that it will be an entirely independent line. The vessels are stated to be of about 2,700 tons, and 500 H.P.

They will have to maintain a high average speed to avoid penalties, and will require three vessels on this side the Isthmus, and probably four or five on the other side.

An interesting episode in the attempts of steam communication with Australia has just been made public, by the tidings of the outward passage of the *Royal Charter*, from Plymouth to Melbourne, in fifty-nine days.

The Artizan, vol. xiii., p. 281, gave a full description of this vessel, and we have not the slightest doubt that she will form the prelude of a great many other vessels.

There cannot be the least doubt that the route *viâ* the Cape of Good Hope will be the one chosen by the bulk of passengers, and necessarily for the carriage of all heavy merchandise, because the transit through Egypt would, of course, be too expensive for all but wealthy passengers and light valuable merchandise.

Should, however, the scheme proposed by M. de Lesseps, for a canal connecting the Mediterranean and Red Seas be carried out, and rendered available for large vessels, that would, of course, shorten the distance and increase the facilities for traffic to India and Australia to an enormous extent.

According to advices from Melbourne, the *Royal Charter* may be expected home in a few weeks, and should her passage back be as good as that out, it will, indeed, be a triumph for the principles she embodies —viz., large-sized ships, full-rigged, and fitted with auxiliary power and hoisting screws.

There is still another road to our Colonies unmentioned—viz., the Pacific route, *viâ* Panama. A company was formed about three years since who proposed its adoption, but their vessels—the *Emeu*, *Black Swan*, *Kangaroo*, and others—were employed as transports in the war, and soon disposed of, partly to a French company and partly for other services.

We have now given a rapid glance at the various attempts that have hitherto been made in establishing a steam communication with our flourishing and wonderfully increasing Australian Colonies, which import from this country about fourteen or fifteen millions' worth of goods, or rather more than is taken from us by the whole of the United States; and which will, no doubt, one day, form an empire more powerful than the world has yet seen.

NOTES BY A PRACTICAL CHEMIST.

Manufacture of Phosphorus.—Hugo Fleek has made considerable improvements in this manufacture, obtaining 6 to 7 per cent. of phosphorus, instead of 4 to 5 per cent., as in the old process, and, in addition, 10 to 20 per cent. of gelatine.

The bones cleaned, freed from fat, and broken up, are treated with dilute muriatic acid, forming chloride of calcium and acid phosphate of lime. The operation is continued until the bone earth is extracted, and only the cartilage remains, which is washed, steeped in lime water, washed again, and used in the preparation of a very superior quality of gelatine.

The liquid (chloride of calcium and acid phosphate of lime) is evaporated down in glazed stone ware pans, heated by the flue from the phosphorus furnace, and concentrated to about 38° Beaume. It is then let off and allowed to cool, when the acid phosphate of lime separates in fine crystals. A second crop of crystals is obtained by concentrating and cooling the mother liquor, and the phosphate still dissolved is thrown down by adding milk of lime. The phosphate thus precipitated is treated with muriatic acid like the residue from the retorts. The acid phosphate is freed from any adhering portions of the mother liquor by pressure between cloths, or exposure on plates of porous earthenware. The dry acid salt is warmed, mixed with 1-4th of charcoal powder, passed through a sieve, and put into the retorts. These are fire-clay cylinders arranged in fives, like the retorts in gas works. The tubes from each five open into a receiver shaped like a muffle, and placed in a channel in which a stream of water is allowed to flow. The first receiver is connected to a second arranged in the same manner. Coal and coke are used to feed the furnace. If the acid phosphate of lime is not perfectly freed from the mother liquor, containing chloride of calcium, hydrochloric acid is obtained during distillation, and the yield of phosphorus is smaller. The residue of charcoal and phosphate of lime from the retorts is incinerated on iron plates heated upon the phosphorus furnace. The ash thus obtained is mixed with the phosphate formed by adding lime to the mother liquor, and treated with muriatic acid. Thus, chloride of calcium and acid phosphate of lime are again obtained, which latter is separated and worked for phosphorus. In this manner the total amount of phosphorus in the bones is extracted.

The cartilages freed from bone earth by muriatic acid, as stated above, are covered with water, and treated with a current of steam, until the solution forms a concentrated jelly, which, when poured into moulds, dries in solid cakes. The employment of concentrated acids for the extraction of gelatine is injurious. If the bones are treated at a gentle heat with muriatic acid of 7° Beaume, and then completely neutralised with lime water, there is no fear of decomposition. The gelatine should not be boiled too long.

A certain "patent gelatine" is often purposely mixed with white lead.

The Torbane Hill Mineral.—Genther has been subjecting this mineral to a careful examination, and pronounces it to be a bituminous shale—not coal. It contains no trace of vegetable cells, and both its ash and volatile products of distillation differ entirely from those yielded by coal.

Spurious Smalts.—Various authors have remarked that smalts are extensively adulterated with chalk and other carbonates, but there is another adulteration, or rather substitution of a far graver character. Artificial ultra-marine of an inferior cast is mixed with finely-ground barytes, gypsum, kaolin, &c., and then sold as genuine smalts, with the mark, F.F.F.F.E. This counterfeit article has often a very fine colour, but is completely decomposed and decolourised by the addition of muriatic acid, or more slowly by sulphuric. A high temperature renders it dingy, and ultimately white; and if moistened with water and dried it becomes dull and spotty.

Picric Acid in Beer.—The high price of hops is leading to the partial employment of picric or carbazotic acid, as a substitute. This may be detected by boiling white unmordanted wool in the suspected sample for ten minutes, and then washing. If picric acid be present, the wool will acquire a canary yellow, varying in intensity according to the proportion.

Blue Sulphur.—Vogel, in analyzing certain minerals, has obtained what he considers to be a blue variety of sulphur. It appeared to be produced on pouring ferruginous solutions (muriatic) into fresh, strong sulphuretted hydrogen water. He intends continuing the investigation with the hope of elucidating the colouring principle of ultra-marines.

Solubility of Silver.—St. Clair Deville observes that silver dissolves with extreme ease and rapidity in hydriodic acid, with disengagement of hydrogen. From this and other phenomena, the author inclines to remove silver from the so-called noble metals, and to rank it with lead.

The common metals are all dissolved by hydriodic acid with singular facility, and even gold and platinum gradually yield to its action.

The Sale of Poisons.—Reformers are too apt to forget that in pulling up weeds we may root out useful plants, with which the former may have become entangled. The recent poisoning cases have drawn a large share of attention to the ease with which evil-disposed persons may obtain the means of secret murder. A certain journal, speaking on behalf of public health, and utterly forgetful or regardless of all other considerations, proposes restrictions upon the sale of a variety of articles, among which our manufacturing friends will perceive, to their amazement, *nitric* and *muriatic acids!* These liquids are, no doubt, in a concentrated state, poisonous, but for secret poisoning they can never be used, as a fatal dose would at once betray itself both by smell and taste. For self-murder they may doubtless be employed, but the man who has resolution enough to swallow such a burning draught would, if prevented from purchasing them, not hesitate to make away with himself in some other manner. Are, therefore, the thousand-and-one manufacturing operations in which these acids are necessary, to be placed under irksome restrictions, in order that some one or two persons annually may be induced to seek another method of suicide ? As well place the Thames under "restrictions," because a number of unfortunate beings seek death in its waters. The manufacturers of England will not, we trust, submit to be thus surgeon-ridden: and the advocates of restriction might do well to remember that monk's hood (aconite) and laburnum grow in every garden, and that hemlock and bella donna adorn our wilds. If poisoners are driven by restrictive laws to seek out these substances, will not crime enjoy greater impunity than at present ? The deadly concoctions of the middle ages were not obtained from druggists and drysalters.

ANSWERS TO CORRESPONDENTS.

"H., B."—Chlorophyll, the green colouring matter of plants, is of no value as a pigment. The colouring matters of animals are all supposed to be derivatives of uric acid. This substance is absent from the excrements of birds during the moulting season, while the new feathers are being elaborated. It has been already made to yield crimsons far more brilliant than those formed from cochineal.

"Agricola."—The molybdate of ammonia is little used in testing for phosphoric acid on account of its high price, as the quantity consumed is large.

AMERICAN NOTES.—No. VIII.

IRON RAILWAY.

Excursion on the New York and Erie Railroad.—A party of gentlemen connected with the railroad interest, lately left the Erie railroad depôt, in Jersey City, in a car provided for the purpose, to witness the operation of a new railway track, which the inventor claims is much superior to the one now in ordinary use.

The new track was laid about three miles from the depôt, but was not in a proper condition for the experiment made upon it.

The improvement consists in substituting wrought and cast iron bars, in place of the wooden sleepers or ties now in use. At each end of the bar is a hollow iron cylinder, solid at the bottom, which rests on a foundation of stone; inside these cylinders is a gutta percha, or India rubber spring, on which a piston or plunger rests, on the top of which is the chair that holds the rail, which is of the ordinary T pattern. The cylinder supports are about a foot and a half long, which puts them far enough below the surface to shield them in great part from cold or wet. The advantages claimed for this improvement are :—

1. It will prove much easier travelling, as the India rubber springs take off the jolting motion so objectionable in railroad travel.
2. It will do away with the wooden sleepers or ties, and the track can be better laid with grass, as it need not be disturbed, and the dust nuisance will therefore be laid at rest.
3. The great saving in repair.

The objections to this invention are :—

1. Its cost, which will be from two to six times as much as the present way of laying rails.
2. The liability of breakage on curves, as the braces are of cast-iron.

The improvement is soon to be further tried on an extensive scale on the Erie railroad, and its success or failure is looked for with much interest, as it promises a saving and accommodation to the travelling public.

KEROSENE, OR COAL OIL.

Kerosene Oil.—This is the designation of a new article of light, which has been introduced here with great success. In consequence, however, of the use of coal gas in all our cities, and most of our towns, the great market for this article is upon the ocean, and in the country. It is acknowledged to be peculiarly suitable for ships' use. Masters of vessels who have tried it, report upon it as the best and most economical light in use. With these recommendations, and my own observation of its merits, but without any personal interest whatever in its success, I am about to presume upon your patience with a detail of its qualities, &c., as derived from a professional chemist in this city:—

New York, February 6, 1856.

The North American Kerosene Company.

Gentlemen,—I have made a careful photometrical examination of your kerosene oil, in comparison with the various kinds of oil, burning fluids, and coal gas, in use in this country, with the following results:—

MATERIAL.	LAMP.	Intensity of Light.	Consumption by Weight.	Specific Gravity.	Consumption by Measure.	Quantity of Light from an equal measure of Oil.	Retail Price of the Oil per Gallon.	Cost of an equal amount of Light.
							dollars	dollars
Kerosene	Kerosene	13·689	475	845	562	2·435	1 00	4 10
Camphine	Camphine	5·625	377	870	433	1·299	63	4 85
Sylvic Oil.	Rosin Oil	1·190	140	970	144	826	50	6 05
Rapeseed Oil....	Mechanical	5·929	329	920	357	1·660	1 50	9 00
Whale ,,	Solar	1·892	211	925	227	833	1 00	12 00
Lard ,,	,, ...	1·640	213	915	232	706	1 25	17 70
Sperm ,,	,, ...	2·025	210	880	238	850	2 25	26 47
Burning Fluid ..	Large Wick	553	154	825	184	300	87	29 00

MATERIAL.	Intensity of Light.	Consumption per hour.	Consumption of Gas to equal Intensity of Oil.	Retail Price of Materials.	Cost of a Light of the same Intensity per hour.
Kerosene Oil.....	13·689	1200 grs.	....	dollars. 1 per gallon.	2 44-100 of 1 cent.
Coal Gas	4·970	5 C.ft.	13·75 C. ft.	3 per M.	4 12-000 of 1 cent.

From the above statement it will be seen that kerosene produces the most light, at the least cost, and that burning fluid produces the least light at the greatest cost.

I have also made a careful analysis of your kerosene oil, and find it to be remarkably pure and free from all substances which would otherwise render it unfit for burning in lamps. When thus purified by the process now in use, it is not explosive, even when heated to 212 deg. F., and being much less volatile than camphine, it is not liable to smoke.

In view of the above facts, I am sanguine that your "purified kerosene" is destined to supersede all other oils or burning fluids, as a source of light for artificial illumination, and would recommend it as the most valuable material for that purpose with which I am acquainted.

Very respectfully, your obedient servant,
EDWARD N. KENT, Chemist.

The agents, in their card to the public, present the following advantages, which are claimed by them in the use of kerosene, viz.:—

Not explosive.

The lamps do not require trimming oftener than once in twenty-four hours; an advantage that will be obvious to every ship master.

It will remain fluid, when the best sperm oil will congeal.

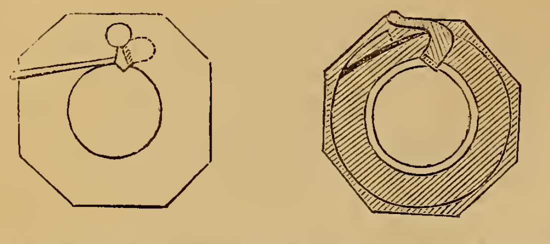
Its unrivalled economy.

This oil can also be burned in all the ordinary solar and hand lamps used on board vessels, including bowsprit and signal lanterns, and gives more light than sperm, whale, or lard oil.

Kingston Goddard's Patent Jamb Nuts.—The following cuts represent (subject to various modifications in detail) the self-acting jamb nuts, invented and patented by Kingston Goddard, of Philadelphia, Pa. This invention is an important one, and destined to assume a high rank in practical value. It is well adapted for carriages, locomotives, water-wheels, steam machinery of all kinds, pumps, printing presses, reaping and mowing machines, and in fact in every machine where nuts are used. It presents to the public a new and invaluable contrivance, and one that will work its way into general use, having received the unqualified approbation of engineers and machinists.

The operation of it, is that of a friction brake, which is so arranged as to prevent the nuts from running off the thread, whilst it offers no resistance to its being screwed up.

The inventor describes it as follows:—The object of my invention is



to make a screw nut, which, when screwed upon the end of the axletree of a carriage, to hold the carriage hub on the axle, or to hold any other rotating body on an axle, will not be liable to be unscrewed either by the turning of such hub or other body, or by concussions, jars, or vibrations, and which at the same time will admit of being readily screwed up or unscrewed by a wrench, without any other operations than that of putting on the wrench and turning it. And my said invention consists in combining with the nut a spring friction brake, which by the tension of the spring shall make friction on the thread of the screw, to prevent the nut from turning, the said friction brake being made to pass through and project outside of the face of the nut, so that in putting the wrench on the nut, the friction brake shall be withdrawn from the surface of the thread, to relieve the friction and permit the nut to turn freely.

STEAM NAVIGATION.

Belgium Transatlantic Steam Ship Line.—This line is about opening communication between Antwerp and New York, with four large iron screw-propellers. The following are the principal dimensions of the two which were built in Antwerp:—

DIMENSIONS OF STEAMERS "LEOPOLD" AND "DUC DE BRABANT."

Built by John Cockerill; Engines by Cockerill and Co., of Antwerp.

Length on deck	286 ft.
Do. on load line	263 ft.
Breadth of beam	38 ft.
Depth of hold at ditto	27 ft. 8 in.
Hull	1843 tons.
Engine room	606 „
Register N.M.	1237 tons.

Kind of engines, direct acting; ditto boilers, tubular; diameter of cylinders, 60 in.; length of stroke, 4 ft.; diameter of screw, 18 ft.; number of boilers, 4; area of immersed section, 705 ft.; frames, L, 6 in. × $3\frac{1}{4}$ in. × $\frac{3}{4}$ in., $5\frac{1}{2}$ in. × $3\frac{1}{4}$ in. × $\frac{5}{8}$ in., and $5\frac{1}{2}$ in. × $3\frac{1}{4}$ in. × $\frac{9}{10}$ in., and 18 and 23 in. apart; number of strakes of plates from keel to gunwale 14; thickness of plates, $\frac{29}{32}$ to $\frac{15}{32}$; number of bulkheads, 5; masts, 3: rig, barque; intended service, Antwerp to New York.

Remarks.—Have plate stringers upon each deck, 32 in. wide and $\frac{1}{2}$ in. thick. Rivets, double laid, $\frac{3}{4}$ and 1 in. diameter, and $2\frac{1}{2}$ and 3 in. apart. Flues, 24 in. high; 2 side keelsons.

Messrs. Pease and Murphy, of the Fulton Iron Works, have just finished two side-wheel steamers for the Island of Cuba and Gulf of Mexico. The dimensions are as follow:—

DIMENSIONS OF STEAMER "CUBA."

Built by William H. Webb; Engines by Fulton Iron Works, of New York.

Length on deck	200 ft.
Breadth of beam	30 ft. 6 in.
Depth of hold to spar deck	13 ft.
Length of engine space, including coal bunkers	40 ft.
Hull } Engine room }	730 tons.

Kind of engine, vertical beam; ditto boilers, return flued; diameter of cylinders, 60 in.; length of stroke, 9 ft.; diameter of paddle wheel over boards, 26 ft. 2 in.; length of boards, 8 ft.; depth of ditto, 1 ft. 6 in.; number of ditto, 24; number of boilers, 2; length of ditto, 23 ft.; breadth of ditto, 10 ft. 2 in.; height of ditto, exclusive of steam chests, 10 ft., number of furnaces, 2; length of fire-bars, 5 ft. 6 in.; number of flues, 6 above and 6 below; internal diameter of ditto, lower flues, $14\frac{1}{2}$ in. × 20 in.; upper flues, $10\frac{1}{2}$ in.; length of upper flues, 16 ft. 9 in.; diameter of chimney, 5 ft. 2 in.; height of ditto, 60 ft.; area of immersed section at load draft, 222 ft.; load on safety valve in lbs. per sq. in., 28; heating surface, 2,400 ft.; draft forward and aft, 8 ft. 9 in.; average revolutions, 17; frames: molded, 10 in., sided, 15 in., and 30 in. apart at centres; independent steam, fire, and bilge pumps, 1; intended service, Island of Cuba.

Remarks.—Has poop cabin, and an enclosed forecastle.

DIMENSIONS OF STEAMER "GUATIMALA."

Built by William H. Webb; Engines by Fulton Iron Works, of New York.

Length on deck	120 ft.
Breadth of beam	22 ft.
Depth of hold to spar-deck	8 ft.
Length of engine-space, including coal bunkers	44 ft.
Hull } Engine room }	210 tons.

Kind of engine, vertical beam; ditto boiler, return flued; diameter of cylinder, 30 in.; length of stroke, 6 ft.; diameter of paddle wheel over boards, 18 ft. 6 in.; length of boards, 5 ft.; depth of ditto, 1 ft. 3 in.; number of ditto, 16; number of boilers, 1; length of ditto, 19 ft.; breadth of ditto, 7 ft. 6 in.; height of ditto, exclusive of steam chests, 8 ft.; number of furnaces, 2; length of fire-bars, 5 ft.; number of flues, 4 above, 6 below; internal diameter of upper flues, $13\frac{1}{2}$ in., ditto, ditto, of lower ditto, 10 × 16 in., and $18\frac{1}{2}$ in.; diameter of chimney, 32 in.; height of ditto, 40 ft.; area of immersed section at load draft, 90 ft.; load on safety-valve in lbs. per sq. in., 25; heating surface, 607 ft.; draft forward and aft, 5 ft. 3 in.; average revolutions, 22; frames: molded, 10 in., sided, 8 to 14 in., and 30 in. apart at centres; independent steam, fire, and bilge pumps, 1; intended service, Gulf of Mexico.

Remarks.—Has poop cabin.

ON WADDELL'S IMPROVED PACKING FOR THE SLIDE VALVES OF MARINE ENGINES.

By Mr. Charles Beyer, of Manchester.

Paper read at the Institution of Mechanical Engineers, Birmingham, April 30, 1856.

Benjamin Fothergill, Esq., V.P., in the Chair.

The mode of packing the slide valves of marine engines, which forms the subject of the following paper, is the invention of Mr. Robert Waddell, of Liverpool, for many years chief engineer of several of the Cunard Mail Line of steam-ships crossing the Atlantic, who has been led by his practical experience of the serious evils and difficulties attending the present usual construction to devise a remedy, which simply and effectually accomplishes the desired object; and appeared to the writer a desirable subject to bring before a meeting of the Institution, as a piece of practical experience that might prove serviceable to the members.

In this country the slide valve is generally used for marine engines, as well as for many other engines, and is particularly suitable, from the simplicity of its construction and other advantages. The difficulties attending its use have arisen from the great pressure under which it has worked, and the consequent friction and wear of the rubbing faces. In large engines, such as those of the Atlantic steamers, in order to allow of the valves being worked by hand for reversing, it has been found necessary to remove a portion of the steam-pressure from the back of the valve, and this has been done either by excluding the steam from a portion of the back of the valve, by means of packings acting between the back of the valve and the casing or valve chest; or by allowing the steam to pass round the portion of the valve between the ports, as is done in the D slide valve. The former method is principally used for short valves; but in marine engines, especially where the stroke of the piston is long, the D valve is mostly employed.

Double-beat valves are employed in the American line of Atlantic steamers, as well as in their river steamers generally, excepting for screw engines, where the great number of revolutions per minute requires slide valves. The double-beat valves are preferred to the D valve particularly in the river steamers, on account of the great increase that has taken place in the size of the engines and the pressure of the steam, and the difficulty that would arise in working the D valve with frequent stoppages of the engines. The double-beat valves of the Atlantic steamers are required to be very large, 19 in. and 18 in. diameter, and they are made each in two pairs, being eight valves for each cylinder, on account of the great size of the cylinders, which are 95 in. in diameter and 10 ft. stroke. The large valve chests involve a loss of steam, and a practical objection is experienced in the difficulty of keeping the valves tight, from the expansion of the valve chests with the ribs and valve seats; and in rough weather, when the vessel is rolling and pitching, the valves do not come fair to their seats; from these causes it is understood that a trial is being made of a different form of valve for the purpose.

In the large steamers crossing the Atlantic, the D valve is constructed in a manner similar to that shown in the vertical section, Fig. 1, Plate liii.

The valve consists of two similar portions, A, A, fixed by nuts on the valve spindle, B, at such a distance apart as to allow the steam ports, C, C, to be near the ends of the cylinder, and consequently short, preventing the loss of steam that would occur with long ports. The ports are faced with brass bars, E, F, upon which the valve faces rub, and the valve has a throw of 18 in. or 20 in. The steam enters the centre part, G, of the valve between the ports, and escapes to the condenser by passing out beyond the ends of the valve at H, H. The back of the valve is made steam-tight by packing rings placed opposite the ports at I, I, which prevent the steam from blowing right through into the condenser.

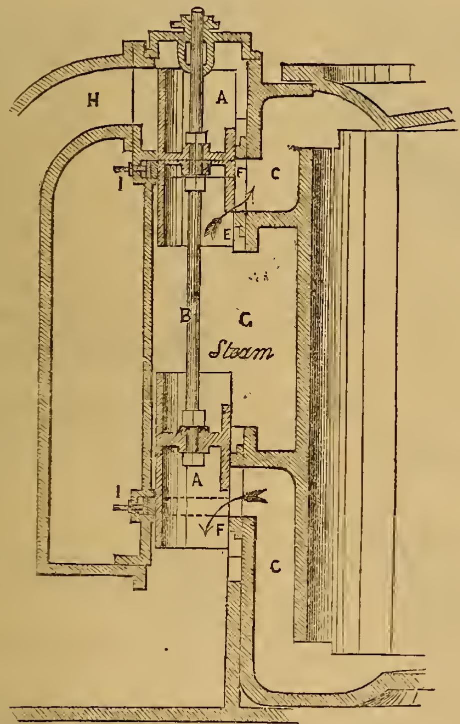


Fig. 1.—Vertical Section of D valve, with ordinary Packing.

The packing is generally formed of a flax gasket with a metal segment behind it, placed in a recess or port in the casing of the steam chest, and is set up to the back of the valve by set screws acting upon the metal segment.

The defects of this ordinary mode of packing the valves lie in the varying pressure of the valve faces upon the bars of the ports, which varies from several tons to nothing, and a pressure tending to separate the valve face from the bars. Taking the steam ports to be each 45½ in. long by 10 in. deep, as in the large Atlantic steamers having 100 in. cylinders, and the packing ports, I, I, at the back of the valve, to be each 3½ in. deep, then, when the valve is in the position shown in the figure, admitting the steam to the top of the cylinder, the pressure of the steam upon the entire area of the packing is unbalanced; or, taking the pressure of the steam at 20 lbs. per sq. in. above the atmosphere, there is an unbalanced pressure of 20 lbs. per sq. in. on an area of 159 sq. in., giving a total pressure of 3,180 lbs., tending to force the valve off the bars against the packing all the time the port is open; and, consequently, the packing must be made by the set screws to exert constantly a pressure of 3,180 lbs. upon the back of the valve, in order to keep it up to the face of the port, and prevent the steam from blowing through into the condenser between the faces of the valve and port. On the other hand, when the port is opened to the condenser, and the valve in the position shown at the lower port in the figure, the pressure of the steam is unbalanced upon the difference between the combined area of the port and steam bar, E, together with the bars at the ends of the ports, and the area of the packing; or, taking the full vacuum at 12 lbs. per sq. in., the extreme unbalanced pressure is 32 lbs. per sq. in. on an area of 412 sq. in., giving a pressure of 13,184 lbs., to which must be added 5,088 lbs., the pressure of the packing, making a total pressure on the back of the valve of 18,272 lbs., or 8 tons, during the time of exhausting.

The very great pressure under which the valves work is necessarily attended with great wear both of the valves and port faces, requiring considerable expense in repairs. The valves are at the same time much more difficult to be worked by hand, requiring two men to handle them in small river steamers in starting the engine; and in large steamers four or five men are wanted for each valve, notwithstanding that the gearing is arranged to give a power of 20 to 1. In some instances, small steam cylinders have been tried for working the valves, in the place of hand gearing, but the writer is not aware what success has attended the change, and it is clear that no diminution of the wear of the valves would be thereby effected.

The most serious practical defect, however, attending the ordinary method of packing the valves, is not so much the great pressure under which they work, as the varying amount of the pressure per square in. between the rubbing faces at different parts of the travel of the valve. The difficulty arising from this source is experienced more particularly in large engines, although occurring in all engines using the slide valve, in proportion to their size, and where the valve is applied on a large scale the amount of the evil becomes very serious. It has been seen that when the port is open to the condenser there is an extreme pressure of 18,272 lbs. on the back of the valve; this is borne by an area of only 114 sq. in. when the port is full open to the exhaust; but when the port is beginning to open the pressure is borne by an area of 144 sq. in.; and the unbalanced pressure at that time is only about 16 lbs. per sq. in., giving a total unbalanced pressure of 9,136 lbs.: hence the pressure between the rubbing faces is 63 lbs. per sq. in. when the steam begins to exhaust, and increases to 160 lbs. per sq. in. when the port is full open, and accordingly the friction on the exhaust side, F, of the face of the port is only 40 per cent. of that on the steam side, E, or 60 per cent. less than the latter; and consequently the steam bar, E, is worn down more rapidly than the exhaust bar, F. In a voyage across the Atlantic and back the faces have been found to wear about 1-32nd in. off the straight on the steam side, and the wear would soon increase to 1-16th in., if they are not re-adjusted. The consequence of this unequal wear is that, when the valve moves back again, closing the port, it is in effect rising up an inclined plane of 1-32nd in., and a clear opening is left underneath, through which the steam blows straight into the condenser, causing waste of the steam and injury to the vacuum. The wear of 1-32nd in. in a port 45½ in. long gives a clear opening of 1⅜ sq. in., through which the steam blows straight into the condenser at the beginning of exhaustion. When the opening to the condenser is closed, the wear of the steam side of the port permits the steam to act as a cushion upon the piston at the end of the stroke, and the same circumstance allows it to continue entering the cylinder after it is supposed to be cut off by the valve. The valve face is of course most worn on the exhaust side, and the total wear of both the valve and cylinder faces depends on the degree of expansion and the amount of lap.

The effects of the unequal wear of the valve and cylinder faces have been felt much more of late years, in consequence of the great increase in the size of marine engines, and the increased pressure of steam, which has been more than doubled in some cases for the purpose of saving fuel by working more expansively; and the trouble and expense that have arisen from this source have probably led, in some instances, to the abandonment of the slide valve. In order to obviate the evil as much as possible, it is necessary that the valve and cylinder faces should be re-adjusted as often as an opportunity offers, otherwise the loss of steam will be very great. In large steamers crossing the Atlantic, the valves are usually drawn on arriving at each port for the purpose of examining the packings, which often require to be replaced; and at the same time the valve and cylinder faces are adjusted. Two or three days are required each voyage for partially adjusting the valve and cylinder faces; and once a year they have to be thoroughly done up—back and faces—which occupies about a fortnight. So much straightening of the cylinder faces soon wears them down, and they require to be renewed in a few years.

The great loss of steam that takes place in this way, from the faces getting off the straight, often escapes observation, as the packings can be adjusted to the back of the valve only when in its tightest position, and whilst the engines are standing. In that position of the valves on the ports there will be no escape of steam into the condenser, the valve faces being on the exhaust bars, F, F, and the packing then fitting close to the back of the valves, which have, consequently, the appearance of being tight, although loss of steam takes place as soon as they are put to work.

The improved mode of packing—the subject of the present paper, is shown in Figs. 2, 3, and 4, annexed, and consists in replacing the single packing ring, I, opposite to each port by a pair of packing rings, K, L, placed opposite to the bars of the ports. The packing may be made in the ordinary manner with a gasket of flax or india rubber, backed by a metal segment, for the set screws to act upon; or a metallic

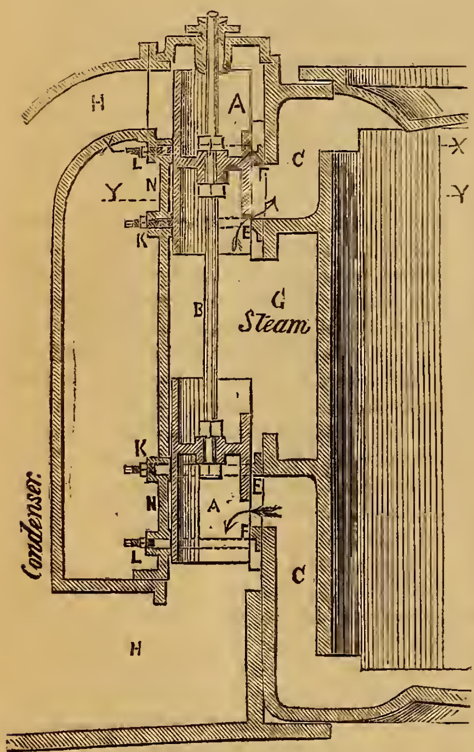


Fig. 2.
Vertical Section of D Valve with Improved Packing.

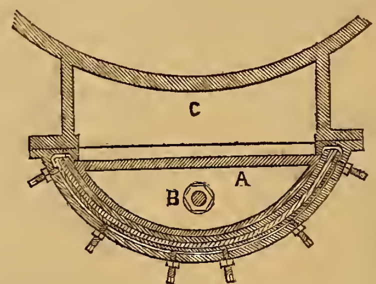


Fig. 3.
Plan at X, X, with Improved Packing.

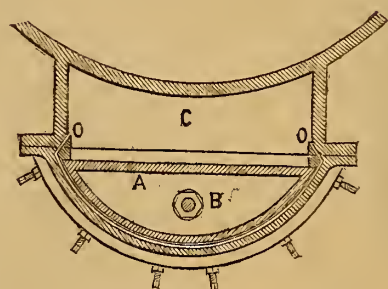


Fig. 4.
Plan at Y, Y, with Improved Packing.

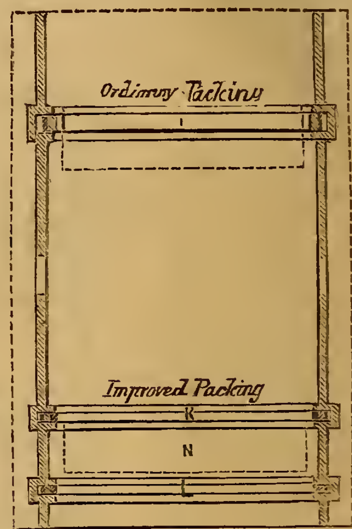


Fig. 5.
Elevation of Back of Valve Chest.

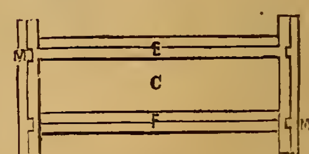


Fig. 6.
Elevation of Bars of Port.

packing ring may be used, and springs may be substituted for the set screws. As the strips of packing are never exposed to the pressure of the steam inside the valve, the pressure to which they are adjusted need be no more than sufficient to prevent the steam blowing through between the valve and the port face. The brass bars at the ends of the port have two small recesses, M, M, Fig. 6, in the outer edge of each, into which the ends of the segments or packing rings may enter as the packing wears down. This will make a tight joint, as the extreme positions of the valve in its travel do not uncover the recesses. The space, N, between the two rings, shown in the section, Fig. 2, and the back elevation, Fig. 5, communicates with the port by a hole, O, Fig. 4, at each end of the port, and by this plan there is always the same pressure on the back of the valve between the packings as in the port. The space, N, is made wider than the port by the amount of the width of one of the packing strips, and the extra area thus provided for steam pressure on the back of the valve replaces the area excluded from steam pressure by the packing strip, K, on the steam side. Hence, this valve is really a balanced or equilibrium slide valve, and is not affected by the amount of pressure of the steam. The wear of the valve and cylinder faces, and also of the packing, is, consequently, very greatly reduced, the total pressure between the rubbing faces being no more than the amount required to keep them always in contact; and the wear that does take place is uniform, instead of being concentrated at a particular part.

The new mode of packing not only removes effectually the objections to the ordinary method, but is itself free from mechanical difficulties, whilst its simplicity renders it as easily applicable as the usual plan, and it may be readily applied to existing engines.

The new packing is applicable also to single slide valves. The steam in this case is admitted at each end of the valve, and the eduction takes place from the centre. The space between the packings at the back of the valve communicates with the port by a passage; and the back of the valve opposite the exhaust port communicates with the port through openings, so that the pressure upon the valve is completely balanced throughout, as in the large D valve described above.

The double-packed valve described above has been practically tried in a pair of large horizontal direct-acting engines of 500 H.P., constructed by Messrs. Randolf, Elder and Co., of Glasgow, for the screw ship *Columbian*, of 2,500 tons burthen. The engines make fifty-eight revolutions per minute, and under this severe test the working of the valves has proved very successful; when drawn, after working for a period of about eight months, they appeared to have worked very smoothly, being in first-rate condition on the back and face. The packings were not found to be much worn, and did not require to be replaced; they had never needed to be tightened up during the voyage, and there was no appearance of escape of steam, as the condensers kept their vacuum for a considerable time after stopping the engines.

The advantages obtained by the new mode of packing the slide valves are :—a balanced valve, unaffected by the amount of pressure of the steam; diminished friction and wear of the rubbing faces; saving in consumption of fuel, by preventing leakage through the valve and diminution of vacuum in the condenser; reduced weight and cost of valve gear, and better control over the engine, consequent upon the diminished power required to work the valves;—and lastly, saving in time, expense, and labour of maintaining the faces, packing, and gearing, in proper working order.

The Chairman remarked that the great amount of friction occasioned by the unbalanced pressure on the valves in large engines, with the ordinary mode of packing, rendered the subject one of much importance. He inquired what material had been found most suitable for packing the valves on the new plan.

Mr. Waddell replied that he preferred to use a brass packing, with a flax gasket behind it to allow of a slight yielding. The new mode of packing had an advantage over the ordinary plan, in admitting of the use of metal packing; in the ordinary plan it was necessary to pack the valves with some material softer than metal, on account of the irregular fit at the back of the valve, from the unequal wear of the face caused by the variable pressure to which it was exposed. The valves had therefore to be packed with a flax gasket, instead of a metallic packing, but in the new plan metallic packing might be used, in consequence of the valve being balanced; and the brass packings that had been tried had been found to answer well.

The Chairman observed that he had experienced the difficulty of keeping the packing tight in the ordinary D valve, and this difficulty would not attend a valve that was fully balanced.

Mr. Shelley asked whether the valves could be repacked without taking them out?

Mr. Waddell said that there were modes of doing so, but it was not necessary in general to make any provision for this purpose, as the valves were usually drawn after each voyage to examine the faces, and the packing was renewed at the same time. With the ordinary packing the unequal wear occasioned by the variable unbalanced pressure caused a rocking and beating of the valves on the bars of the port, when the packing became slack; even in small engines the knocking of the valves might be heard by placing the ear close to the cylinder, and in large engines it was heard at some distance. The defect of the variable pressure was less apparent in small engines, from the breadth of the packing-strip being nearly equal to the port; but in large engines the area exposed to unbalanced pressure was so great that the variation in the total pressure became very serious. In the ordinary D valve the pressure was balanced between the ports, but the portion opposite the ports was left unbalanced, and this unbalanced pressure had not been perceptible with low-pressure steam, but when high-pressure steam was introduced with very large valves in the American vessels, the D slide valve had to be abandoned on this account; were it not for this circumstance the D valve would be more economical than the double-beat valve. It should be observed that any pressure put upon the packing by the pinching screws was doubled in effect, by the valve having a rubbing face both on the front and back.

Mr. Miller inquired whether any experiments had been made to ascertain the saving in the power required to work the valves, when packed in the new manner?

Mr. Waddell replied that in the screw-engines of the *Columbian*, in which the new mode of packing had been adopted, there had been no means of disconnecting the valves to try them fully, but they were found to work easily with the hand-gear; there could be but little power required to work them, since the pressure between the rubbing faces was only the amount necessary to prevent the steam from blowing through, as in the case of pistons with metallic packing, and it was found that if two metal surfaces were well trued up, a very small pressure was sufficient to prevent the steam from penetrating between them. The ordinary packing occasioned a deceptive impression when examined, the valve being considered tight because no steam was detected blowing through into the condenser, when the engine was stopped for examining the packing; but at that time the valve was necessarily in the middle of its stroke and upon the exhaust-bars of the port, this being its tightest position, in which alone the packing could be adjusted; so that any leakage of steam could take place only into the cylinder, and no steam could escape into the condenser; but as soon as the engine was put to work, the steam began to leak through into the condenser, and a great loss of steam took place when the bars were worn.

The Chairman inquired what power was required to work the double-beat valves by hand in the large American steamers?

Mr. Waddell said that two men were generally required to each engine, though one man might be able to work the valves if well balanced, unless the stems were packed too tight; but it was found necessary that the valves should not be too nicely balanced in area, otherwise there was not sufficient effective weight to bring them fairly to their seats when the vessel was rolling, as they were sometimes lying at an angle of 45°, which reduced their effective weight so that they would not fall quick enough. The objections to the double-beat valves and the D valve had been found so serious in those large steamers, that in the engines of the last one, the *Adriatic*, a new kind of cock valve had been introduced by the makers, Messrs. Stillman and Allen.

Mr. Fenton observed that a similar principle had been advantageously applied to steam hammers, by employing a cylindrical valve, balanced all round; he had some of them in use, and they were working satisfactorily.

The Chairman asked whether the area of the bar on the steam side of the port had been included in calculating the area exposed to unbalanced pressure in the ordinary valve.

Mr. Waddell said that the area of the steam bar and also of the bars at the ends of the ports had been taken into account as exposed to the pressure, because it could not be supposed that there was any steam pressure between the valve and the bars, otherwise the steam would blow through. If the bars were made wider the wear would be diminished, by the increase in wearing surface, but the gain would be partly neutralised by the increase in the total unbalanced pressure, and this difficulty had led him to devise the new mode of packing.

Mr. Wymer fully concurred in the statement that had been made of the wear on the back and front of the ordinary D valve; and he considered the new mode of packing would cause a great saving, if it effected all that was stated.

The Chairman mentioned an instance that had occurred lately under his own notice, of a stationary engine working with the ordinary slide, where the engineman had been unable to stir the valve, and had been obliged to get a long lever to move it, involving a risk of accident from the difficulty of controlling the motion, and a serious accident might be occasioned by the valve sticking in this manner.

He proposed a vote of thanks to Mr. Waddell, which was passed.

DESCRIPTION OF A DOUBLE SLIDE EXPANSION VALVE FOR MARINE ENGINES.

By Mr. Francis W. Wymer, of Newcastle-upon-Tyne.

Paper read at the Institution of Mechanical Engineers, Birmingham, April 30, 1856.
Benjamin Fothergill, Esq., V.P., in the Chair.

The writer, feeling convinced of the necessity of using expansion valves for the engines of screw-steamers, applied the valves described in the present paper to the engines of the screw-ship *Lord Raglan*, one of the Tyne and Continental Steam Navigation Company's vessels, built on the Clyde.

The objects sought to be obtained by the application of these valves are, first, to afford a facility for using the full power of the engines when necessary for any length of time, the boilers being made large enough to supply a sufficient quantity of steam, even when cleaning the fires, and to allow of the necessary amount of blowing off at sea. Secoudly, to provide an efficient expansion valve for reducing the power of the engines to any limit required, so as to gain an increased advantage in the results obtained from the consumption of a given quantity of fuel, compared with that which eould be gained by the ordinary practice of wiredrawing the steam by the regulator valve. Thirdly, to provide the means of altering the degree of expansion, without at the same time altering the lead of the valve, or the time of exhausting from the cylinder into the condenser.

The valves are shown in Figs. 1 and 2, annexed; they are a modification of Messrs. Hawthorn's expansion valves for locomotive engines. The slide valve, A, of each engine is worked by a pair of eccentrics, B, B, connected by a link, C, for reversing the motion in the ordinary way. A cut-off slide, D, is placed on the back of the slide valve, A, through which the steam has to pass, and this is worked by a third eccentric, E, through an expansion link, F. The lower end of the link, F, is connected to a concentric ring, G, on the axle, and is consequently stationary, so that by sliding the rod of the cut-off slide, D, to the lower end of the link, its motion is stopped, and the valve remains full open throughout the stroke, the engines then working at their full power. The expansion liuk, F, can be adjusted by the lever, H, to cut off the steam at any point required in forward gear, and the combined action of the two slides gives a more prompt cutting off with less wire-drawing of the steam than in the case of the ordinary siugle slide valve. In backward gear the ordinary slide, A, alone is required to act, the reversiug being effected by the lever, I; the link, C, is used only for reversing, and can be fixed only in the extreme positions of forward and backward gear, the expansion being regulated by the cut-off slide, D, alone.

DOUBLE SLIDE EXPANSION VALVE.

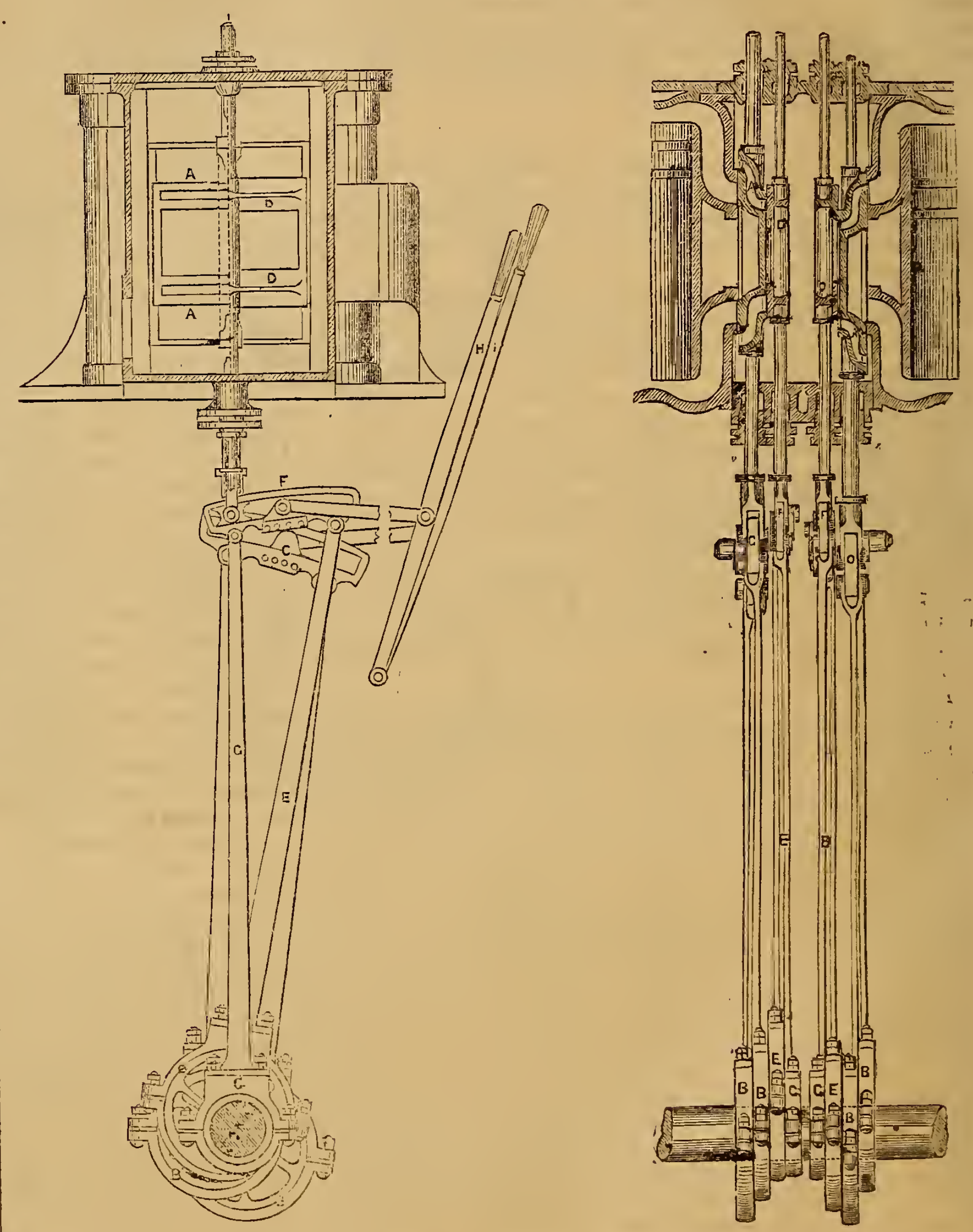


Fig. 1.—Plan at back of Valves.

Fig. 2.—Section through Valves.

In the engines shown in the figures, the pistons have 30 in. stroke, and the main valves, A, are set to cut off at 22½ in. or 3-4ths from the commencement of the stroke. By moving the link, F, to any point between the centres of the two rods, E and G, and thereby varying the length of travel of the expansiou valve, D, the steam may be cut off at any point between 3-4ths of the stroke, when the rod, G, is in full gear and the engines are working at their full power, and ¼th of the stroke, when the rod, E, is in full gear aud the expansion is carried out to the maximum degree.

This arrangement of valves has been in constant use on board the screw steamer *Lord Raglan* for the last nine months, during which time the vessel has run 14,000 miles, and the valves have given every satisfaction as to their efficiency, by the economy of fuel attending the use of them, and by their non-liability to derangement, and the case with which their working cau be regulated at any time according to the situatiou in which the ship may be placed, so as either to employ the full power of the engines, or to economise fuel for a long voyage by working expansively.

The following Table shows the results obtained from experiments at sea, including loss by blowing off necessary to keep the boilers clean, cleaning of fires, &c., incidental to steam navigation.

CONSUMPTION OF FUEL BY THE "LORD RAGLAN" SCREW STEAMER, WITH THE DOUBLE SLIDE EXPANSION VALVE.

Expansion in Per Centage of Stroke.	Number of Strokes per Minute.	Comparative Speed of Ship.	Loss of Speed of Ship.	Consumption of Coal per Hour.	Per Centage Consumption of Coal.	Per Centage Saving of Coal.	Per Centage Gain of Distance run by same Consumption of Coal.
Per Cent.				Cwts.	Per Cent.	Per Cent.	Per Cent.
25	75	100	..	18	100	..	..
33	75 nearly	100 nearly	0 nearly	18 nearly	100 nearly	0 nearly	0 nearly
45	72	96	4	16	86	11	7½
50	69	92	8	13	72	28	22
58	67½	90	10	10	59	44	38

The description of coals used in the above trials was West Hartley.

In consequence of the absence of the vessel in the Crimea, the writer has not been enabled to give the general results up to the present time, as he had expected to do.

Mr. WYMER exhibited a model of the double slide valve, and showed the action of the cut-off slide with various degrees of expansion.

The CHAIRMAN observed that the double slide valve reminded him of the valve invented by the late Mr. Bodmer, which had a cut-off slide acting in a similar manner, and had been tried in several kinds of engines, including locomotives.

Mr. BEYER had used Bodmer's double valves formerly in several locomotives, and had found them work well as long as they were kept in good repair, but they did not stand well, on account of the great rapidity of reciprocation; the single valve and link motion was preferable for locomotive engines. The double slide valves would no doubt answer better for stationary or marine engines, where the motion was slower, as in the arrangement described in the paper.

Mr. FENTON remarked that the addition of the cut-off slide gave a better means for adjusting the degree of expansion; he asked whether it had an advantage in facilitating the exhaust.

Mr. BEYER explained that the exhaust remained always the same, and opened to the full extent for all degrees of expansion, the admission alone being affected by the cut-off slide; and in this consisted the advantage of the double slide over the single valve.

Mr. MILLER asked what metal was used for the valves and cylinder faces in the engines in which the trial of the new valves had been made.

Mr. WYMER replied that both of the valves were of cast-iron, as well as the cylinder faces; they were not found to be worn after running 14,000 miles, but remained in a very good state; the vessel was at present abroad, and the valves had been examined in the week previous to her last sailing. He had at first used the ordinary link motion for marine engines, but had found a difficulty in preventing the engine from "knocking on the centres," in consequence of the increase of lead at high degrees of expansion, and the additional defect of variation in the exhaust that took place with the ordinary link motion; these circumstances affected large engines seriously, although they were not of importance in small quick-moving engines such as locomotives. By the use of the double slide valve that had been been described, the lead was kept the same and the exhaust remained constant for all degrees of expansion, the amount of expansion being regulated by the cut-off slide.

A vote of thanks was then passed to Mr. Wymer for his communication.

ON AN IMPROVED CONSTRUCTION OF LINK MOTION FOR LOCOMOTIVE AND OTHER ENGINES.

By Mr. ALEXANDER ALLEN, of Perth.

Paper read at the Institution of Mechanical Engineers, Birmingham, April 30, 1856.

THE Link Motion used for working the slide-valves of locomotive engines is constructed in two forms, termed the shifting link and the stationary link; in the former, the link is curved towards the axle with the radius of the eccentric rods, and is shifted up or down to reverse the motion of the slide-valve, the valve-rod being prevented from moving vertically. In the stationary link, on the other hand, the link is prevented from moving vertically, and the valve-rod slides up and down in it, the curvature of the link being in the reverse direction, with a radius equal to the length of the valve-rod. The action of the valves is similar in the two cases, except that, with the stationary link, the lead of the slide is maintained constant under all degrees of expansion, whereas, with the shifting-link, the lead increases a little as the degree of expansion is increased.

The improved link motion, forming the subject of the present paper, is shown in Plate lxxxvi., and is in effect a combination of the shifting and stationary link motions, as both the link and the valve-rod are moved at the same time, but in opposite directions.

Figs. 1 to 4 show the new link motion complete, with eccentrics, eccentric rods, and valve-rod, as arranged for a tank engine.

Figs. 5 to 16 show various forms of the link motion, the reversing shaft being placed above or below the link according to convenience.

On the reversing shaft, A, are forged two arms, B and C, on opposite sides of the shaft, the front arm, B, being connected with the valve-rod, D, and the back arm, C, with the link, E, by means of suspending or sustaining links in the ordinary manner. As the arms, B and C, are on opposite sides of the reversing shaft, the vertical movements given to the valve-rod, with the link-block at its extremity, and to the link, are in opposite directions; and their simultaneous movements, but in opposite directions, compensate for the curvature of the ordinary link, and consequently a straight link is substituted, the construction of which is simpler than that of the curved link.

The front arm, B, of the reversing shaft, is made longer than the back one, C, in such a proportion that, for any motion of the reversing shaft, the link, E, and the eccentric rods move through 3-5ths of the vertical space described at the same time by the link-block and the valve-rod, D. On moving the gearing out of the position of midgear, shown in the figures, into the position of full-forward gear, the link-block moves upwards through a distance of 2½ in., the effect of which is to give the valve-rod an obliquity that is equivalent to shortening it up 1-10th in. But at the same time the link moves downwards through a space of 1½ in., and the obliquity of the forward eccentric rod, F, is thus diminished to an extent that is equivalent to lengthening it out 1-10th in. Thus the shortening of the valve-rod is exactly compensated for by the lengthening of the eccentric rod, and the valve will consequently remain stationary, causing the lead to be unaltered. Similarly, when the engine is thrown into the position of full backward gear, the same compensation takes place between the valve-rod and the backward eccentric rod, G, and the valve remains stationary. Hence it appears that as far as regards the positions of full forward and backward gear and of midgear, the proper form for the link must be straight instead of curved. In order that the lead may remain constant in the same manner in the intermediate positions of gear, the correct form of the link ought to be two equal curves, concave towards the valve-rod, having their extremities in the same straight line with the centre of the link, the curvature amounting to not more than about 1-32nd in. for the dimensions of gearing shown in Fig. 1. The error arising from making the link straight, instead of curved in the above manner, causes therefore a total variation of not more than 1-32nd in. in the lead of the valve, and the lead may therefore be considered practically constant, at the same time that the straight form of link has an advantage in simplicity of construction, and more especially in facility of repairs.

The vertical movement of the link being 3-5ths of that of the link-block, the total vertical movement of the link in reversing is therefore only 3-8ths of that in the shifting link motion; and the vertical movement of the valve-rod and link-block is 5-8ths of that in the stationary link motion. The length of the reversing lever is thus proportionately greater, and an increase of power is obtained for reversing; and the expansion can be easily regulated with the full pressure of the steam on the valves. For the same reason less room is required for the gearing than in either of the ordinary link motions, and the boiler may be placed lower on the frame.

The valve-rod being connected to the longer arm of the reversing shaft so nearly counterbalances the link and eccentric rods, which are connected with the shorter arm on the opposite side of the shaft, that balance-weights or springs are dispensed with, and the total weight on the reversing shaft is thus much reduced; at the same time the torsion to which it is subjected is also much diminished, on account of the diminished length of the arms. The entire link motion is carried by the weigh-shaft alone, and no suspending rods from the boiler or framing are needed, the only fixings required being those of the reversing shaft, which may be placed above or below the link, according to convenience.

The results of the working of the new link motion are shown in the diagrams, taken from a Goods engine fitted with the new motion, having cylinders 16 in. diameter and 22 in. stroke, and also in the Tables appended; from which it appears that the new motion is accurate in its working, having a practically constant lead, and causing a nearly equal distribution of the steam in both ends of the cylinder in forward and backward gear. In the diagrams the full line shows the distribution of the steam for the front stroke, from the buffer-plank towards the fire-box, and the dotted line represents the distribution for the back stroke in the opposite direction.

TABLE I.—*Distribution of Steam by Straight Link Motion.*
Stroke of piston, 22 in.; Outside lap, 1 in.; Inside lap, line and line; Steam ports, $1\frac{1}{4}$ in by 12 in.; Exhaust port, $3\frac{1}{4}$ in. by 12 in.

Number of Notch.		Travel of Block in Link.	Lead of Slide.		Travel of Slide.	Total Opening of Slide to Steam.		Point of Cutting off.		Exhaust opens and Compression begins.		Period of Expansion.		Period of Compression.	
			Front Stroke.	Back Stroke.		Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.
		Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Forward Gear.	4	$\frac{7}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$4\frac{9}{16}$	$1\frac{3}{16}$	$1\frac{3}{8}$	79	78	93	92	14	14	7	8
	3	$\frac{3}{8}$	$\frac{1}{4}$ full	$\frac{5}{16}$	4	$\frac{7}{8}$	$1\frac{1}{8}$	71	70	91	88	20	18	9	12
	2	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$3\frac{7}{16}$	$\frac{5}{8}$	$\frac{13}{16}$	56	58	85	83	29	25	15	17
	1	$\frac{1}{4}$ full	$\frac{5}{16}$	$\frac{5}{16}$	$2\frac{15}{16}$	$\frac{7}{16}$	$\frac{1}{2}$	34	40	74	72	40	32	26	28
Mid Gear......	0	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{5}{16}$	$2\frac{5}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	15	19	55	56	40	37	45	44
Backward Gear.	1	$\frac{5}{16}$	$\frac{5}{16}$	$\frac{5}{16}$	$2\frac{3}{4}$	$\frac{3}{8}$	$\frac{3}{8}$	25	25	65	64	40	39	35	36
	2	$\frac{3}{8}$	$\frac{5}{16}$	$\frac{5}{16}$	$3\frac{3}{16}$	$\frac{9}{16}$	$\frac{5}{8}$	49	48	79	78	30	30	21	22
	3	$\frac{1}{2}$	$\frac{1}{4}$ full	$\frac{5}{16}$	$3\frac{7}{8}$	$\frac{7}{8}$	1	66	66	87	86	21	20	13	14
	4	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{5}{16}$	$4\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{3}{8}$	76	75	91	90	15	15	9	10

The Cutting-off, Exhaust, Expansion, and Compression, are given in per centages of the stroke of the piston. The Front Stroke is from the buffer-blank towards the fire-box.

TABLE II.—*Distribution of Steam by Straight Link Motion.*
Stroke of piston, 24 in.; Outside lap, 1 in.; Inside lap, line and line; Steam ports, $1\frac{5}{8}$ in. by 12 in.; Exhaust port, $2\frac{1}{2}$ in. by 12 in.

Number of Notch.		Lead of Slide.		Travel of Slide.	Total Opening of Slide to Steam.		Point of Cutting off.		Exhaust opens and Compression begins.		Period of Expansion.		Period of Compression.	
		Front Stroke.	Back Stroke.		Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.	Front Stroke.	Back Stroke.
		Inches.	Inches.	Inches.	Inches.	Inches.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Forward Gear.........	7	$\frac{5}{16}$	$\frac{5}{16}$	$4\frac{1}{2}$	$1\frac{1}{8}$	$1\frac{3}{8}$	75	72	91	90	16	18	9	10
	6	$\frac{5}{16}$	$\frac{5}{16}$	4	$\frac{7}{8}$	$1\frac{1}{8}$	68	67	89	87	21	20	11	13
	5	$\frac{5}{16}$	$\frac{5}{16}$	$3\frac{3}{4}$	$\frac{3}{4}$	1	63	63	87	85	24	22	13	15
	4	$\frac{5}{16}$	$\frac{5}{16}$ bare	$3\frac{5}{16}$	$\frac{5}{8}$	$\frac{13}{16}$	55	56	84	81	29	25	16	19
	3	$\frac{5}{16}$	$\frac{5}{16}$ bare	$3\frac{1}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	44	46	80	77	36	31	20	23
	2	$\frac{5}{16}$	$\frac{1}{4}$ full	$2\frac{13}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	31	34	73	70	42	36	27	30
	1	$\frac{5}{16}$	$\frac{1}{4}$ full	$2\frac{11}{16}$	$\frac{5}{16}$	$\frac{3}{8}$	21	23	65	61	44	38	35	39
Mid Gear.................	0	$\frac{5}{16}$	$\frac{1}{4}$	$2\frac{9}{16}$	$\frac{5}{16}$	$\frac{1}{4}$	10	10	50	46	40	40	50	54

The Cutting-off, Exhaust, Expansion, and Compression are given in the per centage of the stroke of the piston. The Lead is set equal in forward and backward full gear. The Front Stroke is from the buffer-plank towards the fire-box. The Fore Eccentric Rod is coupled to the bottom of the link.

An improved construction of link, adopted by the writer in connection with the new motion, is shown in Figs. 1, 3, and 4, and consists of two straight rectangular bars, joined together by pieces bolted in between them at each end; each bar has three pivots formed on its outer side, to the centre pair of which the suspending or sustaining links from the reversing shaft are joined, the top and bottom pairs fitting in the eyes of the eccentric rods. The link-block fits in between the bars forming the link, its sides being formed with flanges so as to grasp the bars of the link, and the wearing surfaces of the block are lined with steel, the bars of the link being case hardened. The block is made in two portions, Fig. 4, to allow of readily connecting and disconnecting it from the valve-rod, one portion being formed with a projecting pin, which fits into a corresponding hole through the other portion, so that the two parts move together in the link in the same manner as a solid block. By this means a large wearing surface of all the working parts is obtained, particularly of the block: and when worn out of truth, the link may be ground straight again, and the block may be made up by inserting a small strip of brass or tin behind the steel liners.

The link and block may also be made in the same manner as the ordinary box link, as shown in Figs. 5 to 8; but the construction above described is preferable, from its simplicity and the greater facility which it affords for examination and repairs.

Another form of the double rectangular bar-link is shown in Figs. 9 to 12, in which the two bars forming the link are not connected together by bolts or any other fastening, but the link is left open at both ends; the block is made in two portions, Fig. 12, in a manner similar to that already described, and is retained in its position by flanges formed on the bars of the link, as in the ordinary box-link.

The construction of link preferred by the writer is shown in Figs. 13 to 16, the link being formed of a single rectangular bar of about 2 in. × $2\frac{3}{4}$ in. section, having eyes at top and bottom to receive pins for connecting the eccentric rods. The block is made in the form of a rectangular frame, Fig. 16, surrounding the bar and sliding up and down it, and packed at the back by a lining strip to allow of wear. A more extended wearing surface is thus obtained by the single rectangular bar-link, giving greater durability, and less expense in maintenance.

In place of the ordinary reversing lever and quadrant, the writer prefers to make use of a rack, H, Figs. 1 and 2, on the end of the connecting-rod, I, from the reversing shaft, gearing into a pinion on a vertical shaft, on the top of which is the hand-wheel, K. By this plan the degree of expansion can be regulated with greater nicety, and greater power is obtained for reversing, so that the engineman may do his shunting without shutting off the steam. The rack is held securely in its position by a pinching screw, which is released by a treadle, L, acted upon by the foot; and a graduated scale or rim may be attached at the top of the shaft, in connection with the hand-wheel.

Four engines are now working with the new motion, one of which has been at work for five months, during which time it has run 10,000 miles with very little wear of the motion; several other engines are also being fitted with the improved motion.

The CHAIRMAN regretted that Mr. Allen had been unexpectedly prevented from being present; he had sent two models showing the working of the new motion, one full-size and the other half-size.

Mr. FERNIE had seen the new link motion at work at Perth, and thought it would prove satisfactory in working, and a decided improvement; the motive imparted to the valves was as true as in any motion he had seen, and the reversing was effected with greater ease than in any other motion that he was acquainted with.

Mr. FENTON had also seen the motion at work, and in his opinion it appeared to be the best application of a principle of the link that had yet been made. With the new motion, the boiler might be placed about 3 in. lower than with the ordinary link, and this was an advantage in many engines with large driving-wheels, where the lowering of the boilers was limited by the clearance of the link motion. The ease of reversing was remarkable; the reversing lever might be held by the hand in any position whilst running with the steam on, owing to the several parts of the motion being completely in balance with one another.

The CHAIRMAN asked whether he had seen the single rectangular bar-link that had been described?

Mr. FENTON replied that he had only seen the straight link with double bars; he did not know whether the single bar link was at work yet.

The CHAIRMAN proposed a vote of thanks to Mr. Allen for his communication, which was passed.

The CHAIRMAN said he had much pleasure in informing the Meeting that Mr. Allen had presented to the Institution one of the models of his link motion which had been exhibited. He hoped that others of the Members would follow the example, by presenting models to the Institution, so as to form a valuable collection for the use of the Members.

REVIEWS.

Painting with Both Hands. Chapman and Hall, Piccadilly.

THIS pamphlet is written by Mr. J. Lone, who appears to be ambitious of originating a new style of painting, founded upon the phenomena revealed to us by the stereoscope. He argues that, as the projection of objects obtained by that instrument is effected by the scene impressed upon the left eye, being made to double upon that received by the right, and the reverse; we, therefore, ought to paint our pictures, first with the right hand, and then with the left. That we believe to be his idea; but it matters little. The plain truth is, that the stereoscope is a pleasing optical toy, and has no more to do with pictorial art than Punch and Judy have with the tragic drama. The whole confusion which has been raised by Mr. Ruskin, and rendered worse confounded by Mr. Lone, respecting painting, has arisen from the profound ignorance that too generally prevails, as to what a picture really ought to be, and the true object to which the powers of the artist are addressed.

We have plenty of hands that can paint; at least, as far as hands only can do it, but what we want are heads; therefore if gentlemen, who have as much time to spare as our author appears to possess, would develop a fine-art system of the bicephalus kind, seeing that hands are more easily obtained than heads, they would do much better than mystifying themselves and others upon such impracticable subjects as binocular perspective, and "painting with both hands."

LIST OF NEW BOOKS OR NEW EDITIONS OF BOOKS.

EYRE (V.)—On Metallic Boats and Floating Waggons for Naval and Military Service; with some Observations on American Life-Preserving Cars. The substance of a Lecture, May 2, 1856. By Major Vincent Eyre. 8vo, pp. 64, cloth, 2s. 6d. (Smith and Co.)

HARDWICH (T. F.)—Manual of Photographic Chemistry, including the Practice of the Collodian Process. By T. Frederick Hardwich. 3rd edition. 12mo, pp. 400, cloth, 6s. 6d. (Churchill.)

WEBSTER (T.)—The Principles of Hydrostatics; an Elementary Treatise on the Law of Fluids and their Practical Applications. By Thomas Webster. 4th edition. Post 8vo, pp. 314, cloth, 7s. 6d. (J. W. Parker.)

WHEATLEY.—New Naval Armament; Maximum Force in Minimum Space. By Commander Wheatley. 8vo, pp. 16, 1s. (Hatchard.)

HUGHES (S.)—A Treatise on Waterworks for the supply of Cities and Towns; with a Description of the Principal Geological Formations of England, as influencing Supplies of Water, and Details of Engines and Pumping Machinery for raising Water. By Samuel Hughes. 12mo, cloth, limp, 3s. (Weale's Series.)

PHILLIPS (R.)—A Million of Facts of Correct Data and Elementary Constants in the Entire Circle of the Sciences, and on all subjects of Speculation and Practice. By Sir Richard Phillips. New edition. Post 8vo, pp. 1,230, cloth, 12s. (Darton.)

*BOWLER (G.)—Chapel and Church Architecture; with Designs for Parsonages. By the Rev. George Bowler. Folio (Boston), with 41 plates, some coloured, half-bound. London, 52s. 6d.

*HASLETT AND HACKLEY.—The Mechanic's, Machinist's, and Engineer's Practical Book of Reference; containing Tables and Formulæ for use in Superficial and Solid Mensuration; Strength and Weight of Materials, Mechanics, Machinery, Hydraulics, Hydrodynamics, Marine Engines, Chemistry, and Miscellaneous Recipes. Adapted to and for the use of all classes of Practical Mechanics. Together with the Engineer's Field-Book. By Charles Haslett, Civil Engineer. Edited by Charles W. Hackley. 12mo. (New York), pp. 512, morocco, tuck, gilt edges. London, 16s.

*HEWITT (A. S.)—On the Statistics and Geography of the Production of Iron: a Paper read before the American Geographical and Statistical Society, on the 21st Feb., 1856, at the New York University. By Abram S. Hewitt; and printed at the request of the Society. 8vo. (New York), pp. 38, with plate, sewed. London, 2s.

HOMANS (B.)—United States Railroad Directory for 1856. Compiled by Benjamin Homans. 8vo. (New York), cloth. London, 6s. 6d. Continued annually.

*MARBLE-WORKER'S MANUAL: designed for the use of Marble-Workers, Builders, and Owners of Houses; containing Practical Information respecting Marbles in general, their cutting, working, and polishing; Veneering of Marble, Painting upon and Colouring of Marble, Mosaics, Composition, and Use of Artificial Marble, Stuccoes, Cements, Receipts, Secrets, &c., &c. Translated from the French, by M. L. Booth. With an Appendix concerning American Marbles. Foolscap (New York), pp. 256, cloth. London, 6s.

* All preceded by an Asterisk are new American Works.

CORRESPONDENCE.

THE CAUSES AND REMEDY OF THE UNPROFITABLE STATE OF SHIPBUILDING.

(*To the Editor of* The Artizan.)

SIR,—Shipbuilding at the present time presents the strange anomaly of capitalists not being able to compete with men of comparatively small means in the construction of vessels; yet such is an admitted fact in the nineteenth century, which boasts of the immense improvements in the application of machinery to our daily wants; so that while in other branches of commerce the larger capitalist is driving the smaller out of the market by the means of expensive machinery, it is in shipbuilding quite the reverse, on account of the profits being so very precarious. With the present system, no one possessed of ordinary prudence would adopt it as a lucrative investment for capital; yet this is the case in one of the largest branches of commerce wherein England claims pre-eminence over the whole world. In other branches of commerce, we can import the raw material from the most distant parts of the world, and return it to them in a manufactured state cheaper than it can be manufactured where it is produced, merely from those aids to labour which have rendered this country the workshop of the world, and which are continually decreasing the amount paid for labour: but in shipbuilding the amount paid for labour goes on increasing year by year, the effect of which will be the means of compelling our shipbuilders to cease the building of new vessels. As it is, our most eminent builders are driven out of the market for low-classed vessels, depending entirely on the repairing of vessels for a living, and building first-class vessels merely for their own use; the reason for a such a state of things arises from the uncontrollable demands of the workman, and from the imperfect system in the management of the labour. The remedy forms a most important subject for consideration, so that we may place capital in its proper position; make builders more independent of the workman—make the labour of the shipwright less scanty in proportion to the price paid for it—find out a method by which sufficiently skilled labour can be easier produced on an emergency, and bring the shipwright to that proper position, with respect to his employer, which ought to exist in every well-conducted business. Such is the problem I have here proposed, and which ought to receive the most serious consideration of every one who has the interests of his country, and the improvement of shipbuilding, at heart; so as to enable this country to excel the rest of the world in economy and excellence of shipbuilding as it does in every other mechanical art.

Before proceeding with this inquiry, it will be necessary to state that the present practice in the construction of vessels has remained stationary for centuries; in consequence, it must either be admitted that the present system is perfection, or that it is radically wrong. In answer to this query it can safely be asserted that it is in such a state as we might imagine the cotton manufacture was in before the invention of the spinning-jeuny—the introduction of the division of labour—and the other appliances which have rendered it so lucrative, and which have increased the cotton manufacture to its present immense extent. In shipbuilding, with a shipping trade of such magnitude as we possess, the adoption of such improvements would render it the most profitable investment in this age of progress, but from the magnitude of the operations required to carry out such improvements in shipbuilding, I am afraid no single capitalist would undertake them ; it would require an energetic company to carry out such improvements so as to overcome the prejudice and the combinations of the workman. Old systems and notions must be discarded ; new discoveries and appliances must be brought to bear on shipbuilding, for the purpose of affording fresh and larger openings for the employment of capital.

With these preliminary observations I would now ask, What is the remedy ? Division of labour is of the first and greatest importance : if there are six divisions of labour required in making a pin, certainly twenty would not be too many in shipbuilding. The simple introduction of a minute division of labour would increase the produce of shipwrights' labour a hundred per cent. With the present system, or rather, non-system, the produce of labour is scanty—it is small in quantity, poor in quality, and of a kind but imperfectly adapted to supply existing wants ; the remedy is obvious—the division of labour will increase the quantity, improve the quality, and render it more suitable to its purpose. The produce of labour is scanty, because shipbuilders do not use aright the means of making it large that are within their reach, nor avail themselves to the full advantage of the proper means which are of such immense advantage in other branches of commerce. The steam-engine, for example, has been invented and brought to a state of almost miraculous perfection, yet it is scarcely employed in shipbuilding, nor have machinery, the division of labour, nor, in short, any of the modern appliances of skill and science, been rendered available for the service of the shipwright. The reason that these helps to labour are not so employed is, that they are so costly as to exceed the means of any single capitalist to make them profitable: none but a powerful company, with large capital, can properly avail themselves of the advantages to be gained.

In this age of improvement the great secret of success is in producing the article or the qualified workman in the shortest possible time ; yet, in shipbuilding, it requires seven years to produce a shipwright, and then we have oue who is generally imperfect in some part of the business. It was the system of being able to supply skilled work rapidly by the division of labour that enabled the engineers, a few years ago, to resist the unreasonable demands of their workmen : the system of a seven years' apprenticeship is playing into the hands of the workmen. But division of labour in shipbuilding, and the simplicity of each operation assigned to each workman, will not require that degree of skill necessary to finish the whole of the ship. Each division might easily be acquired in a month. The difficulty, theu, of attaining the requisite skill, is diminished in the proportion of the one separate part to the whole, and with it the term of apprenticeship, or time spent in acquiring that skill. Besides which, from this undivided attention to a single part, a higher degree of excellence and despatch in that one part is attained, than if attention were distracted by the performance of many other parts. Lastly, since each separate process is assigned to a different workman, and every hand thus attains to the highest degree of skill in his own part, it results that the whole of the work, through all its stages, is performed in the best style, and the article is turned out complete, and of unrivalled excellence, in the shortest possible time.

The next important consideration after the division of labour is a form of vessel that shall possess the greatest advantage for the application of machiuery ; such a form can be obtained by adopting a celebrated French sectional form, combined with increased length, and which might aptly be termed an average of the forms adopted by our most eminent builders. This form would possess every requisite for a good merchant vessel. The form suggested would possess the following advantages :—4-5ths of the timbers, planking, deck, beams, &c., would be of the same form ; and from the expansive nature of the form suggested, the same machinery would be applicable to all sized vessels ; the form itself would create a saving of 10 per cent. in the material, and from its simplicity a great saving of labour would be effected, independent of the division of labour. Such a form would effect a complete revolution in the art of shipbuilding; and it is necessary for the successful and economical application of machinery to shipbuilding, so as to place it on a level with the gigantic improvements of the present century.

With respect to the application of machinery to shipbuilding, will it be credited that, with the great quantity of heavy material used in the construction of vessels, there is scarcely a yard in the kingdom—including Her Majesty's dockyards—that possesses a traversing crane over the vessel. If such a crane be profitable for a contractor to erect over a single undertaking, how much more so would it be over a building slip, where a number of vessels could be built under it ? The greater portion of the material is carried by men—the dearest of all methods for the conveyance of material—in consequence of the absence of tram-roads and properly constructed yards, entirely adapted for shipbuilding.

In the application of sawing machinery a more minute division is absolutely necessary, and of the utmost importance, so as to make each operation easy to the most ordinary capacity, and enable the shipbuilder to be more independeut of skilled labour. It is my humble opinion that if it were contrived solely for each operation, viz., the siding of the timber and the turning out of the timber (keeping in view that 4-5ths of the timbers are the same form), in connection with a better system in the bevelling and laying off the timbers, the produce of the sawing machinery could be increased 200 per cent. above Hamilton's Patent, or the sawing machinery in Woolwich dockyard. Normand's (of Havre) style of giving the bevels a name is a step in the right direction.

And again, in the planking and decks with 4-5ths of it the same form, an ordinary machine for cutting mouldings, or planing, would produce the planking and decks complete for the side of the vessel, and at equally as cheap a rate ; in fact, the greater part of the machinery required for shipbuilding has been already introduced in other arts ; shipbuilding has only to adopt it to reap its advantages, without the great outlay of expense and experience which has brought it to its present perfection.

Lastly, it is from the system of making so large a part of each vessel of the same form, and of assimilating the process in the construction of vessels for the application of machinery, that the most stupendous improvements in shipbuilding will be effected. It is a well-known fact that every operation which exists in the mere repetition of one single action, or set of actions, may be better executed by machinery than by mauual labour. Mechanical genius is not rare, but would quickly display itself in ample measure if only the operation for the application of a machine was offered to it. Hardly anything in the application of mechanism seems too difficult for execution, after the prodigies which have already been effected in that department ; but then the work to be done by the machine must be large, otherwise the expense of its construction will not be repaid. The most sanguine or farseeing imagination can hardly over-estimate the results to be expected from the future application of machiuery to shipbuilding. By these means the wealth acquired by Arkwright, Peel, &c., by the introduction of machinery to the cotton manufacture, may easily be exceeded, and not a little fame will attach to the names of the promoters of the enterprise.

It is by the means of such appliances as have been here described that Great Britain has excelled the whole world in the economy and excellence of its manufactures ; without them in shipbuilding, we are compelled to witness the humiliating fact that a great part of our shipping trade is carried on by American and colonial-built vessels,—a class of vessels the use of which completely solves the question, whether it is more profitable to possess two vessels costing £20,000 that will last ten years, or one vessel for the same sum to last twenty years. Let me answer this question by an abstract from the returns made by the Board of Trade for 1854. It appears that in that year there were built and registered in the Uuited Kingdom 592 timber sailing-vessels, tonnage, 115,807 : the number of colonial-built vessels, 66, tonnage, 43,003, all from the North American colonies—a large increase over the previous year. Of foreign-built vessels the number was 267, tonnage, 97,641, nearly a threefold increase over the previous year ; and that there were 738 vessels, tonnage, 168,843, belonging to the United Kingdom wrecked in that year. By the above returns it appears that 25,000 tons of colonial and foreign-built vessels were added to our mercantile navy over the united efforts of all the shipbuilders of the United Kingdom,—such returns proving that low-classed vessels are the most profitable and in the greatest demand.

What a reproach to the shipbuilding energies of this country, to allow such an amount of tonnage to be added to our mercautile marine by others than themselves ! Well might our shipbuilders during the late war find a great difficulty in supplying the wants of our Government, from the scarcity of shipwrights. It is to be hoped that the difficulty of supplying any future contingencies of the Government will enable it to see the immediate necessity of allowiug shipbuilding timber to be imported free of duty, as well as foreign-built vessels. It is a strange anomaly of free trade, to fetter our shipbuilding trade with such a tax on their energies on the face of such au increase of low-classed vessels.

I have made a slight, although necessary deviation from my subject, to point out the immeuse increase of low-classed vessels (say a seven-years' grade), in our carrying-trade, on which vessels, from the cheapness of the materials used in their construction, the labour forms the most important item in their cost. It is with this class of vessel, especially the larger size—the building of which is rapidly leaving this country—that the practical improvements here suggested become of such great importance. At the lowest calculation the labour, by means of the division of labour, machinery, &c., will be decreased 70 per cent.; by the adoption of the form previously suggested a saving of material of

10 per cent.; and, with the duty, if taken off timber (an additional 5 per cent.), it may safely be estimated that such appliances would reduce the cost of a vessel 30 per cent., and she would, at the same time, possess the additional advantage of being British built.

Such are the pecuniary advantages offered to the British capitalist, at a time when capital is seeking fresh fields for investmeut. It may safely be asserted that no other branch of commerce offers such advantages, and capital thus invested would give such a stimulus to our shipbuilding trade as to enable us to re-assert our superiority over the rest of the world in the economy and excellence of our vessels. When we consider the immense extent of our shipping trade, and its continual increase, with a loss of 700 vessels every year, the demand for vessels must always be large. All the necessary requirements are already in existence to produce such a demand as to enable these suggestions to be carried out to the greatest extent, and, consequently, in the most profitable manner. It is a source of wealth we possess within ourselves, that requires only to be revealed to produce the most astonishing results. With such means, shipbuilding then could only be carried on by the large capitalist — the mere adventurer not being able to compete — consequently, it would be the means of restraining the trade within its legitimate requiremeuts, and preventing those serious fluctuations in the value of shipping which are so prejudicial to both the shipbuilder and shipowner. It is time that this modern cup of Tantalus was destroyed, which is ever raising hopes of success to those interested in our shipping trade, to find them utterly prostrated by the mere adventurer, at that point when a profitable return for their capital seemed to be within their grasp.

In conclusion, it is the interest of every well-wisher to our naval supremacy to give this subject his most serious consideration, so as to raise the science of naval architecture and the art of shipbuilding to that proud position of being one of the most scientific and profitable investments of capital of the day; and I again assert that it will only be effected by means of a powerful company becoming the focus for condensing those conflicting opinions iu the form of vessels which are so detrimental to the best interests of the science of naval architecture.

I am, Sir, yours truly, R. Armstrong.

TUBULAR BOILERS FOR WESTERN RIVER STEAMBOATS.*

Some of the engine builders in Cincinnati and Pittsburgh, are introducing into boats now constructing for service upon the Ohio and Mississippi rivers, boilers in which the return heat is conveyed through tubes, instead of large flues. This is one of the most important changes that has beeu made iu Western steamboat motive apparatus since its establishment upon these rivers; and it is one that cannot fail to produce good results, for, in connection with the annexed resolution of the inspectors of steamboats, fixing the pressure of steam in proportion to the thickness and diameter of the shell of the boiler, it must operate to lessen, if not banish, the disastrous consequences of collapse and explosion. As in the east, no doubt but tubular boilers will be found to give every satisfaction to the engineers under whose charge they shall be placed, when the experience of the constructors shall have perfected them in the best manner of securing the tube ends to prevent leakage; and the best proportion of space between contiguous tubes, to secure evaporative efficiency with facility of access, for removal of scale and mud. In those noted, the tubes are about 14 ft. long, 3 in. diameter, and 1 in. apart, which is closer than usual in the practice of many eastern marine engineers, who have learned that the steam-producing quality of a tubular boiler does not depend upon the number of the tubes, but upon the proper proportion between their aggregate area and that of the grates.

When the tubes are crowded in, the excess is not only a wasteful expenditure of costly materials, but is hurtful, as the draft is made sluggish by the too great area; the water capacity of the boiler is diminished, and the upper rows of tubes are liable to become over-heated from being deprived of intimate contact with the water, the spaces being mainly occupied by the passage of the steam bubbles formed upon the lower tubes and the shell. A preventive of the latter defect would be increasing the spaces between the tubes of the horizontal rows as they approach the surface of the water; say, for example, where the tubes are of 3 in. diameter, let the spaces of the bottom row be 1 in.; of the next row, 1 and 1-8th; next 1 and 1-4th, and so on, increasing by eighths, or any other quantity that may be determined by the number of the rows. This disposition will also afford a better chance for the insertion of the tools required to loosen the scale upon the lower tubes, and for repairs.

"*Resolved*— That the following Table is hereby adopted, for the guidance of local inspectors in the performance of their duties :—

Diameter of Boilers.

Pressure equivalent to the standard pressure for a 42 in. boiler $\frac{1}{4}$ in. iron."*

Wire gauge.	Thick. of Iron.	34 ins. in diameter.	36 ins. in diameter.	38 ins. in diameter.	40 ins. in diameter.	42 ins. in diameter.	44 ins. in diameter.	46 ins. in diameter.
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	$\frac{5}{16}$	169·85	160·41	151·97	144·37	137·50	131·25	125·54
2	$\frac{14}{48}$	158·52	149·72	141·84	134·75	128·33	122·50	117·17
3	$\frac{13}{48}$	147·20	139·03	131·76	125·12	119·16	113·75	108·80
4	$\frac{1}{4}$	135·88	128·33	121·57	115·50	110·00	105·00	100·43
5	$\frac{11}{48}$	124·55	117·63	111·44	105·87	100·83	96·25	92·06
6	$\frac{10}{48}$	113·23	106·94	101·31	96·25	91·66	87·50	83·69
7	$\frac{3}{16}$	101·91	96·24	91·18	86·62	82·50	78·75	75·32

W. J.

* From the "Journal of the Franklin Institute."

* Copied from a printed card intended for the use of the Inspectors and Engineers of the Western Rivers.

PARTICULARS OF THE IRON STEAMER "JEFFERSON DAVIS." †

Hull and Machinery built by Merrick and Sons, Philadelphia. Intended Service, Surveying the Lakes by the Topographical Engineers, United States War Department.

Hull:—Length ou deck .... 138 ft.
Breadth of beam at midship section ...... 21 ft. 6 in.
Depth of hold .... 8 ft. 9 in.
Length of engine aud boiler space .... 36 ft.
Breadth " " .... 10 ft. 6 in.
Shaft, forward of stern post, at deep load liue........ 50 ft. 6 in.
Draft of water at deep load line .... 6 ft.
" " below pressure and revolutions .... 5 ft. 11 in.
With 100 tons of coal and stores.
Tonnage, custom house........ 250
Area of immersed section at deep load draft .... 120 sq. ft.
Contents of bunkers in tons of coal 110
Masts and rig—One mast, with jib, speucer, and square sail.

Engine—One vertical steeple—condensing; diameter of cylinder, 50 in.; length of stroke, 4 ft.; maximum pressure of steam in pounds, 25; cut-off, Allen and Wells' variable; maximum revolutions per minute, 25; boiler, 1 horizontal return tubular; length of boiler, 13 ft.; breadth of ditto, 10 ft.; height of ditto, inclusive of steam drum, 15 ft. 6 in.; height of ditto, exclusive of ditto, 10 ft. 6 in.; weight of ditto, 34,000 lbs; number of furnaces, 4; breadth of furnaces, each $23\frac{3}{4}$ in.; length of grate bars, 7 ft. 3 in.; number of flues or tubes, 172; internal diameter of flues or tubes, 3 in.; length of flues or tubes, 8 ft. 6 in.; heating surface, 1,496 sq. ft.; diameter of smoke pipe, 3 ft. 6 in.; height of ditto above steam drum, 25 ft. 6 in.; description of coal, anthracite; draft, natural; consumption of coal per hour, 560 pounds; paddle-wheels, iron radial, overhung; diameter over paddles, 19 ft. 4 in.; length of ditto, 5 ft. 3 in.; depth of ditto, 1 ft. 6 in.; number of ditto, 20; dip of wheels at load draft, 3 ft.; average revolutions per minute at above draft, 22, with 22 in. steam, cutting-off at 20 in. of stroke.

Remarks.—Hull of iron; bottom plates $\frac{5}{16}$; sides, $\frac{1}{4}$; garboards double rivetted to keel, which is $6 \times 1\frac{1}{2}$, solid with stem and sternpost; shell single rivetted; clincher built; frames, 2 ft. apart, of T iron $3 \times 3\frac{1}{2}$; main deck beams, $4\frac{1}{2} \times 4$ T iron; of cabin and forecastle decks, $3\frac{1}{2} \times 3\frac{1}{2}$. There are two water-tight bulkheads, one forward, and one abaft the coal bunks extending alongside the machinery. Has a sunken or trunk cabin aft, having its top flush with rail, and of 2 in. pine. Main deck of 3 in. piue. There are three yellow pine keelsons 12×14, extending the whole length of the floor, and firmly secured to the frames. Has a deck house, aud above it, forward, a pilot house with steering apparatus. The waterway, outer streak, plank shear, waist and rail, are of wood. Her guards are built light, being required simply to protect the wheels, and are braced by iron knees aud tie-bolts with king-posts. They may be removed, so that the vessel can pass the canal between the Lakes. This steamship was built in Philadelphia, and left on the 26th May, under steam for Buffalo, on Lake Erie, *viâ* the St. Lawrence and Welland Canal. J. V. M.

† From the "Journal of the Franklin Institute."

ROYAL SCOTTISH SOCIETY OF ARTS.

The Royal Scottish Society of Arts held an extraordinary meeting in the Upper Room, Queen Street Hall, ou Monday, 14th July, 1856, Professor George Wilson, M.D., F.R.S.E., President, in the chair.

The President reported from the Council the generous foundation of a biennial prize or medal of ten sovereigns, by General Sir Thomas Makdougall Brisbane, Baronet, G.C.B., G.C.H., &c. &c., of Brisbane and Makerstoun.—On the motion of Richard Hunter, Esq., the thanks of the Society were unanimously voted to Sir Thomas for his muuificent gift; aud, on the motiou of the Secretary, a cast from Mr. Gall's bust of Sir Thomas was ordered by the Society.

The following communications were made :—

1. *On the Manufacture of Ropes and Paper from the Stem of the Hollyhock.* By Mr. James Niven, gardener to William Stirling, Esq., of Kier. Communicated by the President. Specimens, in illustration, were exhibited.—This invention relates to the application or employment and use of the common garden hollyhock, or the althea rosea of Linnæus, and other plants in the natural family malvaciæ, in the manufacture or productiou of the pulpy material or fibre from which paper is to be made, as well as iu the manufacture or production of fibrous material for textile purposes. In the adaptatiou of these plants, or their varieties, they may be used either in a green or dried state; they are prepared by being broken up by any of the ordinary means as hitherto used for the disintegration of vegetable fibres—the whole plant being suited, after disintegratiou, for the production of pulp for the manufacture of paper. Its adaptation as a substitute for rags and other materials now used will be easily demonstrated. 1. Because of the bulk of pure available fibre it produces, the stems attaining the height of from 8 to 10 ft., even under ordinary cultivation, the only loss in weight being in the separation of the mucilaginous matter which they contain. 2. Because of the permanency of the crop, and the tendency of the root to stool like the willow, thereby producing with its age a greater number of stems, the strength of which may be easily upheld by the application of portable or liquid manures. When the crop requires renewal, the roots, which contain a large amount of farina, should be bruised in the manner of making starch from the potato, aud the fibre left is at once suited for the fabrication of a quality of paper, even stronger than that which can be produced from the stems; the farina being also available either as a substitute for starch or food for animals. It is also known that the hollyhock contains a large amount of colouring matter, which, being little inferior to iudigo, might also be extracted, and thus the whole plant appropriated to useful purposes. Its suitability for the manufacture of rope is alone sufficient to cause it to be extensively cultivated; an acre of plants, when established, producing from three to five tons of available fibre for this purpose. The average quanity of fibre suited for the paper manufacture per imperial acre will be about fifteen tons; this arises from the inner boon of the stem beiug pulped down with the outer fibre.—Thanks voted to Mr. Niven, and also to the President iu communicating and exhibiting the specimens.

2. *On the Swedish Safety Lucifer-Match.* Communicated by the President. The match was exhibited.—The safety lucifer-match is the invention of Lundstrom, a Swede, who has a large match manufactory at Jonkoping, in Sweden, where some hundred workmen are employed, and eight or more millions of matches are produced daily. They are about to be introduced into this country by the firm of Bryant and May, London, who are the largest importers of German and Swedish lucifers in the kingdom. A patent has been taken out in their name for the sale in England of the Swedish match. Its peculiarity cousists in the division of the combustible ingredients of the lucifer between the match and the friction-paper. In the ordiuary lucifer, the phosphorus, sulphur, and chlorate of potash, or nitre, are all together on the match, which ignites when rubbed against auy rough surface. In the Swedish matches these materials are so divided that the phosphorus (which is employed solely in the amorphous, slightly combustible, form) is placed on the saud-paper, whilst the sulphur, and a minimum amount of chlorate, or nitrate of potash, is placed on the match. In virtue of this arraugement, it is only when the phosphorised sand-paper and the sulphurised match come in contact with each other that ignition occurs. Neither match nor sandpaper, singly, takes fire by moderate friction against a rough surface. The matches are thus much less liable to cause accident by casual ignition than the ordinary ones; and the recent edict by the Spanish Government against the employment of lucifers by the peasantry of the forest-districts in dry weather (which will certainly be evaded) would be needless if the Swedish matches were in general use. If they fully answer the announcements of the inventor, and it is due to him to acknowledge that they excited great interest at the Exhibition in Paris last summer, they will soon displace the common lucifer, in virtue alike of their manufacture being much less injurious to the health of the workmen who make them, and to the property of those who use them.—Thanks voted to the Presideut for this communication.

NOTES AND NOVELTIES.

Russian Railways.—M. Docknovoski, Inspector of Public Works in Russia, has arrived in Paris, in order to study the system of railroads in France; it being the intention of the Russian Government to commence and carry them on on a vast scale throughout the empire.

A New Lighthouse on the Needles Rock is at length about to be erected. The present one is on the mainland, close to the Needles, and is so often enveloped in fog that it is almost useless. The new lighthouse, built on the rock furthest, will be rarely invisible, and will be a far better guide to the narrow entrance of the Solent than the existing one.

The Danubian Steam Navigation Company.—This Company, the largest in the world, has between eighty and ninety steamers, sixty or seventy steam-tugs, above 400 enormous barges, and first-rate wharfs, &c. Notwithstanding these advantages, it is in some danger of being beaten on the Lower Danube by more enterprising French and English companies. The company's three fastest steamers which run between Pesth and Galatz are built on the American system, with saloon decks. The Company also possess a small and very long steamer, drawing only 14 in. of water, which was constructed in America.

Latent Heat.—We are glad to learn that the very interesting scientific research and experiments upon this subject made by Mr. George Rennie, C.E., F.R.S., and communicated by him at the last meeting of the British Association for the Advancement of Science, and which were, upon that occasion doubted or disputed by some philosophical members, have been recently presented upon a larger scale, and under circumstances which can admit of no doubt. The experiments—by which the development of the latent heat in water by agitation is now proved to an extent beyond that which Mr. Rennie formerly advanced—are of the most simple and convincing character, and will be duly brought before the proper section at the next meeting of the Association.

Improvements in the Manufacture of Iron.—Some exceedingly important and highly interesting experiments have recently been made by Mr. H. Bessemer, connected with the conversion of crude pig-iron from the blast-furnace, into fine malleable iron by one operation, and without any re-heating. The process is one of the simplest; at the same time, one of the most ingenious and philosophical, that we ever remember to have witnessed—it promises greatly to revolutionise the iron manufactures of this country; and if the experiments performed upon a moderately large scale exhibit such a large saving in wages, materials, plant, and time, the vast economy of the process will enable those iron-masters using it to retrieve the hopes of past bad times—at the same time to supply a better and cheaper article.

New Vessels.—Messrs. Scott Russell and Co. have recently launched a fine screw iron paddle steamer, named the *Lyons*, intended io ply between Newhaven and Dieppe. Her dimensions are as follow:—Length between perpendiculars, 190 ft.; breadth of beam, 21 ft. 6 in.; depth of hold, 11 ft; tonnage, O. M., 415 tons; oscillating angular engines of 160 H.P. On trial she made an average speed (with and against tide) of 15·2 knots per hour. She is the third vessel built by this firm for that passage, and the fourth will shortly follow, being now nearly completed. Within the last fortnight, five iron mortar boats have been launched by the same firm, to be followed by two others, and a despatch boat of novel construction for the Government. The monster ship building in the same yard now presents a scene of great activity, and is advancing as rapidly as such a huge undertaking can reasonably be expected to do.

Clayton's Patent Brick-making Machine.—In consequeuce of the extraordinary interest manifested iu, and the attention devoted to, the trials of field instruments and ploughing by steam, at the late meeting at Chelmsford, in addition to the change of arrangements this year on the part of the society with respect to trials and prizes for implements generally, our attention was unfortunately diverted from the important machine for making bricks, the invention of Mr. Henry Clayton, of the Atlas Works, London, and which formed one of a class this season to compete for the Society's prize. We now supply the omission from the rough notes of a friend. There were several brick-making machines entered to compete for the prize, but, for reasons with which we are unacquainted, only two of them (the machines of Clayton and Chamberlain) made their appearance on the show ground—Mr. Clayton's machine being placed for operation at stand No. 3 in the yard for machines in motion. The appearance, as well as the novelty of this machine (being the first time it has been exhibited at the shows of the Royal Agricultural Society of England), created considerable attraction and deserved attention. The judges and engineers engaged on the occasion, accompanied by the stewards, were in attendance to test the capabilities of this machine (the exhibitor of the other machine referred to declining, for some cause, to put his machine in competition), which was worked by one of Clayton and Co.'s small portable steam-engines. The machine was subjected to *two* trials, the first having reference to the power required, and the second to the productive capabilities of the machine. The result was highly satisfactory, the machine producing the extraordinary number of 210 bricks in five minutes, or at the rate of 25,200 bricks per ten hours' working. The machine during this trial was attended by only two men and two boys. The result of the working, the regularity of operation, and the quality of the bricks produced, appeared to astonish everybody present. The judges very properly awarded their prize to this machine.

We may observe that Mr. Clayton received the gold medal of honour at the Paris Exposition for his brick-making machines. The machine was worked at intervals during each succeeding day of the show, and formed one of its most novel features.—*Bell's Weekly Messenger.*

Erratum.

Page 124, col. 2, 14 lines from bottom—*for* "Geversran" *read* "Gevers Van."

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 22nd March, 1856.

689. C. Carey, 32, Union-grove, Wandsworth-rd.—Omnibuses.

Dated 29th March, 1856.

768. C. D. Gardissal, 10, Bedford-st., Strand—Machinery for sweeping streets, &c.

Dated 23rd April, 1856.

969. I. and G. Myers, Rotherham—"Fire-lighter."

Dated 25th April, 1856.

997. R. Lakin, Stretford, Lancaster, J. T. E. G. Fitton, and F. A. Fitton, Ardwick, Manchester—Machines for preparing and spinning cotton and other fibrous substances, some of which improvements, relating to apparatus for lubricating, and to the construction of studs, are also applicable to machinery for other purposes.

Dated 13th May, 1856.

1123. A. Parkes, Birmingham—Use of collodion in photography.

Dated 14th May, 1856.

1135. W. Pollock, Paisley—Manufacture of ornamental fabrics of the lappet class.
1140. A. Meillet, 39, Rue de l'Echiquier, Paris—Artificial stone for grinding, sharpening, and polishing.
1145. W. Evans, Sherston, Malmesbury—Plough.

Dated 15th May, 1856.

1149. J. Y. Simpson, M.D., Edinburgh, and Professor W. Thomson, Belfast—Production of lubricating oil from a new material.
1151. R. Foulds and W. Bracewell, Barnoldswick—Power looms, constructed on what is called the loose reed principle.

Dated 16th May, 1856.

1160. J. Martin, Liverpool—Machinery for draining or partially drying certain descriptions of wheat and other grain.

Dated 21st May, 1856.

1199. R. Pemberton, Hildenborough, Tonbridge — Barrel organs.

Dated 22nd May, 1856.

1224. C. Barreswil, Paris—Gas meters.

Dated 23rd May, 1856.

1236. J. Gedge, 4, Wellington-st. south, Strand—Means of adjusting the parts of ladies' dresses called "crinolines" and "sousjupes."

Dated 28th May, 1856.

1277. O. Whittaker aud C. Wallwork, Hurst, Ashton-under-Lyne—Weaving figured fabrics.

Dated 2nd June, 1856.

1297. H. Cartwright, The Dean, Broseley—Application of steam-cocks to steam-engines, and in working such engines thereby.
1299. G. Gidley, 14, Clinger-st., Hoxton, and W. Christopher, 2, Oak-villa, Pinner—Reducing the bottle or imported india rubber to a transparent liquid state, so that it may be used as a transparent varnish or solution for mixing with colours.
1307. D. Avery, Essex-st., Strand—Construction of bonnets and other coverings for the head.
1312. G. H. Cottam and H. R. Cottam, St. Pancras Iron Works, Old St. Pancras-rd.—The manufacture of iron hurdles.

Dated 3rd June, 1856.

1323. F. A. Verdeil, M.D., 30, Rue St. Sulpice, Paris—Obtaining a particular green colouring matter from artichokes and thistles.

Dated 4th June, 1856.

1324. J. Briggs, Fleet-st.—Blocks and bricks for building.
1325. T. Morris, Bunney, Nottingham—Trap for beetles and other insects.
1326. F. A. Gatty, Accrington—Instrument to be used in lighting and holding matches or vesta lights.
1327. A. Bullough, Blackburn—Mode or method of leasing warps.
1328. W. Potts, Handsworth—Sepulchral monuments.
1329. R. B. Wigley, Birmingham—Method of attaching handles to coffins.
1330. E. Hatton, Birmingham—Manufacture of plain and ornamental metallic tubes.
1331. D. Morrison, Bordesley Works, Birmingham—Manufacture of metallic bedsteads and other articles to sit or recline on.
1332. C. L. Marle, Hotel du Continent, 46, Leadenhall-st.—Improvements in preserving animal and vegetable substances suitable for food.
1333. D. Morrison, Bordesley Works, Birmingham—Manufacture of articles from malleable cast iron.
1334. J. Christophers, Heavitree, Devon—Knives and forks whose handles are not metallic.
1335. R. A. Brooman, 166, Fleet-st.—In plating glass to render it reflective.
1336. W. Smith, 82, Margaret-st., Cavendish-sq.—Improvements in apparatus for regulating the supply of air to furnaces.
1337. A. L. Gibon and A. Frohlich, 39, Rue de l'Echiquier, Paris—Economising fuel in the treatment of metals.

Dated 5th June, 1856.

1338. J. Betts, Strand—Preparation or manufacture of artificial spheres.
1339. J. Norris, jun., New York—Manufacture of the cutting tools employed in nail making machines.
1340. J. Le Breton, 18, King's Arms Yard, Coleman-st.—A photo-gas or apparatus, with air-draughts of hot oxygen when applied to oil lamps, with wicks for lighting and heating.
1341. A. E. Brae, Leeds—Apparatus for communicating signals from one part of a railway train to another.
1342. A. Sinclair, Birmingham—Wrought-iron pins for railway chair fastenings.
1343. W. W. Hewitson, Headingley, near Leeds, and W. H. Bartholomew, 15, Brunswick-ter., Leeds—Construction of the furnaces or fire-boxes of tubular steam-boilers.

Dated 6th June, 1856.

1345. D. Lang, Greenock—Obtaining and applying motive-power.
1346. J. Robinson, jun., Hyde, Chester—Railway chairs, or in means for securing rails thereto.
1347. C. Beyer, Gorton, near Manchester — Locomotive engines.
1348. R. Harlow, Stockport—Construction of water-closets, and in valves or taps for water-closets and other purposes.
1349. J. Somerville, Glasgow—Weaving.
1350. C. D. Gardissal, 10, Bedford-st., Strand—Machinery for extracting fibrous and other products from vegetable substances.
1351. J. Juckes, Dame-st., Islington—Furnaces of locomotive boilers.
1352. T. Chambers, jun., of Colkirk, Fakenham—Agricultural drills.
1353. P. A. le Comte de Fontainemoreau, 31, Rue de l'Echiquier, Paris—Heating water for steam-boilers.
1354. A. V. Newton, 66, Chancery-la.—Rotary engines.
1355. P. Ellison, St. Helen's, Lancashire—Furnaces, and the mode of working the same, for the manufacture of black ash or crude soda.

Dated 7th June, 1856.

1356. A. Stamm, Buenos Ayres—Presses for packing, parts of which improvements are also applicable to other presses.
1357. A. V. Newton, 66, Chancery-la.—Furnace for heating soldering irons.
1358. W. E. Wiley, 34, Great Hampton-st., Birmingham—Manufacture of metallic pens and penholders.
1359. W. D. Ruck, Topping's-wharf, and V. Touche, 14, Rathbone-pl., Oxford-st.—Manufacture of paper from fibres not hitherto applied to such purpose.
1360. S. Dyer, Bristol—Reefing, furling, and setting the sails of ships and vessels, also for protecting such sails from wet and other abuses caused by ropes and rigging.

Dated 9th June, 1856.

1361. A. Robertson, Dublin—Inkstand.
1362. J. B. Howell, Sheffield — Manufacture of cast-steel tyres for railway locomotive engine and carriage wheels.
1363. C. W. Siemens, 7, John-st., Adelphi—Engines wherein super-heated steam is used.
1364. W. Field and E. Jeffreys, Shrewsbury—Machinery for sowing seed and for distributing manure.
1365. R. Ferrier, Jedburgh—Apparatus for sweeping and cleansing roads and streets.
1366. J. Holdin, Manchester—Machinery for washing rags, which said improvements are also applicable for washing other materials.
1367. J. Holdin, Manchester—Machinery for bowking, bleaching, dyeing, and washing textile fabrics or materials.
1368. J. H. Johnson, 47, Lincoln's-inn-flds.—Construction of rails for railways, and in the mode of securing the ends of rails for railways.
1369. J. Ellis, Heckmondwike—The manufacture of muriate of ammonia and carbonate of ammonia, and in converting certain ingredients employed therein into an artificial manure.
1370. B. Smith and W. Kalthoff, Gemund, Cologne—Economising fuel in locomotive and other steam-engines.
1372. R. A. Brooman, 166, Fleet-st. — Ladies' wearing apparel.

Dated 10th June, 1856.

1373. T. Skaife, Vanbrugh-house, Greenwich—Spring folding camera shutters for the more speedy and convenient mode of taking photographic pictures than has been hitherto adopted.
1374. H. Wagner, Everett-st., Russell-sq.—Beds and mattresses, and in similar articles of bedding.
1375. R. A. Brooman, 166, Fleet-st.—Printing shawls and other fabrics, and in the machinery employed therein.
1376. W. Brookes, 73, Chancery-la.—The treatment of corn.
1377. C. Pietroni, London-wall—Printing on cloth and other fabrics.
1378. P. M. Parsons, Duke-st., Adelphi—Improvements in the permanent way of railways.
1379. C. R. Cheshire and J. Betteley, Liverpool—Manufacture of anchors.
1380. A. E. Preux, Paris—Warming railway and other vehicles.
1381. A. V. Newton, 66, Chancery-la.—Projectiles for ordnance.
1382. W. Wilson, Newcastle-upon-Tyne — Machinery for pulling the hair from coney and other skins.

Dated 11th June, 1856.

1383. H. B. James, Derby—Moulding metallic castings.
1384. W. H. Westwood, T. Wright, and E. Wright, Queen's-cross, Dudley—Improved stop or regulating valve.
1385. W. Bayliss, Birmingham—Manufacture of ornamental metallic tubes.
1387. J. Combe, Belfast—Machinery for carding and roving tow, and other fibrous substances, part of which improvements is applicable for transmitting motion in other mechanism.
1388. A. V. Newton, 66, Chancery-la.—Breech-loading fire-arms. *Dated 12th June*, 1856.
1389. R. A. Brooman, 166, Fleet-st. — Manufacture of spoons, forks, and other similar articles, and in the machinery employed therein.
1390. J. Eives, 17, Cornhill—Machinery for extracting oil from oleaginous seeds.
1391. P. W. Hardwick, Gibson-sq.—Tickets for railway and other uses.
1392. P. Unwin and J. Unwin, 124, Rockingham-st., Sheffield—Manufacture of pen and pocket knives.
1393. D. Spill, Stepney-gn.—Purifying spirits of tar or coal tar naphtha.
1394. J. Fairclough, Liverpool—Expander and contractor for dining tables.
1395. J. Stenhouse, 15, Upper Barnsbury-st., Islington—Preparation of a decolourising material, suitable for the treatment of acid, alkaline, and neutral solutions.
1396. C. J. Lewsey, Albion-ter., Commercial-rd. East—Sugar cane mills.
1397. G. L. Stott, St. George's, Gloucester—Purifying gas.

Dated 13th June, 1856.

1398. T. Cowburn, Manchester—Valves for reducing the pressure of steam or other liquids or fluids.
1399. W. Massey, Manchester—Looms for weaving.
1400. C. J. Dumery, Paris—Machinery to be used for manufacturing shoes and boots.
1401. W. R. Whitmore, Cambridge-ter., Clapham-rd., Surrey—Multitubular steam boilers.
1402. W. Mason, Pembroke-dock, Pembroke—Rowlock for boats.
1403. J. Le Cappelain, 42, New Bridge-st., Blackfriars—Machinery for bending sheet iron into corrugated forms for constructing beams.
1404. S. De Jong, 17, New Hampstead-rd.—Warming and ventilating apartments and buildings.
1405. W. Jacot, Molyneux-pl., Water-st., Liverpool—Fire-arms.
1406. P. A. le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Improvements in ship-building.

Dated 14th June, 1856.

1407. H. Mège, Paris—Manufacture of bread.
1408. J. Bunnett and J. G. Bunnett, Deptford—Manufacture of sash-bars, columns, and mouldings, for building and decorative purposes.
1409. J. E. Machard, Annecy, Piedmont—Printing or dyeing skeins, tissues, or other textile fabrics of cotton, wool, flax, aud other fibrous substances.
1411. P. A. le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Metallic packing for stuffing boxes and pistons.
1412. E. A. Aublet, Paris—Rotary engines.
1413. W. Wright, Forth-st., Newcastle-on-Tyne—Manufacture of articles of glass and plastic materials by means of pressure.
1414. W. Seed, Preston—Improvements in "Lap machines," or apparatus used in the preparation of cotton and other fibrous substances for spinning.
1415. E. Lindner, New York, U.S.—Breech-loading fire-arms. *Dated 16th June*, 1856.
1416. J. Sutcliffe and J. Leech, Rochdale—Machinery or apparatus for opening, cleaning, and preparing cotton, wool, and other fibrous substances.
1417. C. Desnos, Bedford-st., Strand—Furnaces for consuming smoke.
1418. E. Guérin, Paris—Self-acting apparatus for working railway brakes.
1419. W. H. Barlow, Derby, and W. H. Woodhouse, Parliament-st.—Connecting and securing the ends of rails of railways.
1420. J. B. Mannix, Westminster—A method of applying locomotive power to the working of inclines.
1421. W. Turner, Tunnicliffe, G. Hulme, 4, George-st., Rochdale, and H. Blackburn, Milnrow—Condensing and other carding engines, billies and mules for carding, slubbing, and spinning woollen, cotton, or other fibrous substances.

Dated 17th June, 1856.

1422. J. Gedge, 4, Wellington-st. South, Strand—Building materials. (A communication.)
1423. J. Gedge, 4, Wellington-st. South, Strand—An improved pump reservoir, and apparatus for measuring liquids.
1424. J. Davis, Birmingham—Method of manufacturing the small coke, commonly called breezes, which said method of manufacture economises heat, and effects the suppression or partial suppression of smoke.
1425. H. Holland, Birmingham—Manufacture of umbrellas and parasols.
1426. J. Sadler, J. Green, and T. Davis, Birmingham—Manufacture of hinges.
1427. A. G. Baylis, Redditch, Worcestershire — Improvements in needles.
1428. J. Eives, 17, Cornhill—Dynamometer.
1429. J. H. Johnson, 47, Lincoln's-in-flds.—Treatment of sugar canes, and in the apparatus employed therein.

1430. F. C. Bakewell, 6, Haverstock-ter., Hampstead—Percussion bomb shells.
1431. W. Baynton, High-st., Bilston—Rolling rails for railways.
1432. A. Depai, 53, Rue de Bercy, Paris—Brakes for railways.
1433. C. Nickels, Albany-rd., Surrey, and J. Hobson, Leicester—Weaving when Jacquard or other ornamenting apparatus is employed.

Dated 18th June, 1856.

1434. R. L. de Berenger, Enfield—Nosebags.
1435. T. Burton, Padiham, Burnley—Machinery for sizing and dressing warps, yarns, or threads.
1436. W. H. Tucker, Fleet-st.—Locks and latches.
1437. M. A. Muir and J. McIlwham, Glasgow—Looms for weaving.
1438. C. Clifford, Temple—Boat-lashings, and in blocks and apparatus used for raising and lowering boats and other articles.
1440. C. P. Sharpley, Berry's-cottage, Chapel-st., Stockwell—Paddle-wheels for propelling vessels.

Dated 19th June, 1856.

1441. G. Tillett, Clapham—Bedsteads.
1443. F. G. Spilsbury, Chaudfontaine, Belgium—Soda and alum.
1444. G. L. Molesworth, 13, Beaufort-bldgs., Strand—Improved pendent child's cot.
1445. T. Schwartz, 67, Gracechurch-st.—Brick.
1445. W. Hunt, Tonge, Middleton—Machinery for polishing and finishing yarns or threads.
1446. G. Pye, Ipswich—Improvement in preparing silk.
1447. W. Mills, 2, Lower Craven-pl., Kentish-town—Pianofortes.
1448. W. Parsons, 18, Pratt-st., Old Lambeth—Washing and bleaching woven fabrics.
1449. J. D. Damazio, Lisbon—Process of making illuminating and heating gas by a double distillation without retort.

Dated 20th June, 1856.

1451. E. H. Cradock Monckton, Bengal Civil Service, and 77, Chancery-la.—Pianofortes.
1452. J. T. Pitman, 67, Gracechurch-st.—Method of using the electric current or currents for telegraphic and other purposes.
1453. J. Bullough, Accrington—Looms.
1455. J. Hague, Ashton-under-Lyne—Machinery for manufacturing bands or cords for driving machinery and other purposes.
1456. M. T. Crofton, Leeds—Apparatus for inking stamps used by bankers and others.
1457. H. Pigott, Glasgow—Hats and other coverings for the head.
1458. S. T. Jones, Royal Circus-st., Greenwich, and J. Harris, Dolgelly—Amalgamating machine to extract gold and silver, and to separate iron from crushed mineral ores in water.

Dated 21st June, 1856.

1459. J. B. Howell, Sheffield—Manufacture of cast-steel tyres.
1460. E. Ventrê, Paris—Improved carton or box for keeping papers or other articles.
1461. G. Davies, 1, Serle-st., Lincoln's-inn—Apparatus for measuring and indicating the leakage of vessels.
1462. E. R. Handcock, 16, North Frederick-st., Dublin—Improvements in mechanism connected with engines to be worked by steam or other motive power.
1463. W. A. Gilbee, 4, South-st., Finsbury—Locomotion on railroads, part of which improvements are also applicable to ordinary roads.
1464. C. Minne and A. Colson, Brussels—Making bread.

Dated 23rd June, 1856.

1465. W. V. Miller, Portsmouth—Propelling vessels.
1466. J. C. Lacroix, Heutrégiville (Marne), France—Filthing and shaving the merino, plain satin, and muslin of wool.
1467. J. Johnson and W. Blackwell, Ashton-under-Lyne—Improvements in self-acting mules for spinning.
1468. G. Gurney, Bude, Cornwall—Improvements for warming and moistening air.
1469. R. Roger, Stockton—Machinery employed for the cultivation of land.
1470. J. A. Longridge, 17, Fludyer-st., Westminster—Obtaining and applying motive power for the conveyance of minerals, pumping, and other purposes in mines in which motive-power is required.
1471. G. Riley, 1, The Grove, Lambeth—Improved refrigerator for cooling brewers' and distillers' worts.
1472. J. Miller, Drogheda, Ireland—Furnaces for more effectually consuming the smoke, and economising the fuel employed therein.
1473. H. H. Vivian, Bernhardt Gustav Hermann, and William Morgan, Hafod Works, Swansea—The manufacture of copper, and in obtaining gold and silver from the ores employed in such manufacture.
1474. G. Dyson, Tudhoe Iron Works, Durham—Manufacture of iron.
1475. I. Atkin and M. Miller, Nottingham—Machinery for sewing lace and other fabrics.
1476. C. Mills, 8, High-st., Camden-town—Hammer rails of pianofortes.

Dated 24th June, 1856.

1477. E. Hardon and J. Henry, Stockport—Looms and machinery for communicating motion to looms and other machines.
1478. J. Taylor, Hackney-rd.—An improved vessel for containing chemicals for the generation of disinfecting gases.
1479. J. Saxby, Brighton—Mode of working simultaneously the points and signals of railways at junctions to prevent accidents.
1480. D. Davies, Wigmore-st., Cavendish-sq.—Wheel tyres.
1481. J. Harrison, Blackburn, and C. Gelderd, Lowmoor, Clitheroe—Machines for warping and sizeing, or otherwise preparing yarns or threads for weaving.
1483. J. H. Johnson, 47, Lincoln's-inn-flds.—Railway breaks.
1484. L. Bower, Birmingham—Improvement in the manufacture of bolts, rivets, spikes, &c.
1485. S. S. Robson, 45, West-st., Gateshead—Improvements in railway and other carriage breaks.
1486. A. Pope, Edgware-rd.—Manufacture of steel.
1487. J. E. Lafond, Belleville, Paris—Lighting.
1488. A. V. Newton, 66, Chancery-la.—Life-boat.

Dated 25th June, 1856.

1489. C. D. Gardissal, 10, Bedford-st., Strand—Engraving glass and crystals.
1490. H. L. Buff, 9, Fitzroy-sq., and F. Versmann, 3, Forest-pl., Kingsland-rd.—Purifying and softening water.
1491. M. Allen, 39, Cavendish-grove, Wandsworth-rd.—Arranging and working the slide-valves of steam-engines.
1492. A. Keiller, Dundee—Manufacture of articles of confectionery.
1493. G. A. Bates, Wigan—Apparatus for the prevention of accidents in ascending and descending shafts of mines.
1494. J. Rohead, Glasgow—Hats and other coverings for the head.
1495. R. W. Chandler, Bow, and T. Oliver, Hatfield—Engines employed for agricultural purposes.
1496. T. Sheller, Waedenschweyl, Switzerland—Obtaining and applying motive power.
1497. J. H. E. Mareschal, Paris—Hydraulic presses.
1498. J. Platt and J. Whitehead, Oldham—Machinery for making bricks.
1499. J. Kenyon and R. Kenyon, Bury—Fabric to be used in printing and other similar purposes, and a method of joining or connecting the ends of the same.
1500. L. Cornides, 4, Trafalgar-sq., Charing-cross—Ornamental metal, wood, leather, textile fabrics, and other substances.

Dated 26th June, 1856.

1501. G. Durrich, Stuttgart, Wurtemberg—Gas burners.
1502. J. Gratrix, Preston, and A. Knight, Birmingham—Apparatus for registering a permanent record of the speed of steam or other engines, which apparatus is also applicable to Watchmen's Registers, and other similar purposes.
1503. H. Waller, Lickhill, Wilts—Vessels used in the manufacture of cheese.
1505. D. Macdonald, Glasgow—Printing textile fabrics and other surfaces.
1506. J. Portus, Morpeth, New South Wales—Wheeled carriages.
1507. J. Aikman, Paiseley—Treatment, cleansing, or finishing of textile fabrics.
1508. F. J. L. Malezieux, Paris—Improvements in the preparation of peat, and in the manufacture of the same into fuel, charcoal, and gas.
1509. J. J. Foot, Spital-sq.—Weaving narrow fabrics.
1510. B. Scariano and R. P. de Villamil, 10, Rue Lepelletier, Paris—Apparatus for measuring and setting out the forms of garments.
1511. W. Hudson, Burnley, and C. Catlow, Clithero—Looms for weaving.

Dated 27th June, 1856.

1513. A. Shanks, 6, Robert-st., Adelphi—Improvements in machines for drilling, boring, and cutting medals.
1514. C. A. Preller, Lant-st., Southwark—Unhairing and preparing skins, and in tanning.
1515. J. H. Johnson, 47, Lincoln's-inn-flds.—The production of carbonate of barytes.
1516. D. Bethune, Cambridge-ter., Hyde-park—Apparatus for separating the more fluid particles from the more solid of various bodies.
1517. E. Burnand, Moudon, Canton de Vaud, Switzerland—The manufacture of fire-arms.

Dated 28th June, 1856.

1518. G. H. Ormerod, Newchurch, Whalley, Lancashire—Machinery for brushing and cleaning cotton fabrics.
1519. E. Brown, Henry Street Works, Sheffield—The casting of sailors' and other pocket-knife handles, and scales.
1520. G. White, 5, Laurence Pountney-la., Cannon-st., City—Improved poultice.
1521. E. Vincenzi, Turin (Piedmont)—Jacquard machines.
1522. B. G. Sloper, Kentish-town—Freezing, refrigerating, and cooling, and in the machinery employed therein.
1523. Rev. R. Reid, Glasgow—The treatment or preparation of oils to be used for lubricating.
1524. E. Travis, Oldham, and J. L. Casartell, Manchester—Improvements in machinery for testing or ascertaining the lubricating quality of oils or other unctuous substances.
1525. W. McAdam, Glasgow—The manufacture of articles of clay and such like plastic substances.
1526. C. A. Messager-Abit, 39, Rue de l'Echiquier, Paris—Improvements in the treatment of fibrous substances.
1527. A. E. L. Bellford, 10, Bedford-st., Strand—Drying, burning, and cooling bricks, tiles, and other ceramic substances.
1528. R. Orrell, J. Cleminson, and W. Barraclough, Low Moor, Bradford—Steam boilers, for preventing explosion thereof.
1529. T. F. Henley, Bromley, Middlesex—Improved process for obtaining arrack or spirit from rice or other grain.

Dated 30th June, 1856.

1530. S. J. Goode, Aston—Gas stoves, and the application of the same to the ventilation of buildings.
1531. E. Rogers, Abercarn, and H. Mackworth, Clifton—Cooking, and in apparatus for that purpose.
1532. A. V. Newton, 66, Chancery-la.—Safety pocket for coats and other garments.
1533. H. Brown, 33, Nelson-sq., Nelson-st., Bermondsey, and J. Bartlett, 23, Little Guildford-st., Southwark—The construction of an iron easy arm-chair bedstead.
1534. C. Moriarty, 22, Nelson-st., Greenwich—The construction of tube brushes used in cleaning the tubes of marine, locomotive, and all kinds of multitubular boilers.

Dated 1st July, 1856.

1535. W. H. Ludford, Fredworth, Gloucestershire—The manufacture of brooms and brushes.
1536. C. W. Goodhart, Woodlands—Bars or gratings for the security of buildings and other property.
1537. F. G. Sanders, Poole—The manufacture of ornamental floor and other tiles, bricks, slabs, and other similar articles.
1538. A. Wild, Windsor—The Manufacture of boots and shoes.
1539. J. C. Haddan, Cannon-row, Westminster—The manufacture of projectiles, and in firing or discharging them from cannon.
1541. D. G. Hope and W. A. Fairbairn, Manchester—Improvements in steam engines.
1543. G. Harvey, jun., Glasgow—Machinery for boring and drilling.
1545. G. T. Bousfield, Sussex-pl., Loughborough-rd., Surrey—Propelling and steering vessels when the force of water is used.
1547. J. Hay, Hay's Mill, Leith, and J. Hay, Edington Mills, Berwickshire—The production of pearl barley.

Dated 2nd July, 1856.

1549. J. H. Johnson, 47, Lincoln's-inn-flds.—Manufacture of cast steel.
1551. P. Heyns, Poplar—Axles, boxes, and wheels for carriages.
1553. W. F. Spittle, Birmingham—Improvement in braiding or plaiting machinery.
1555. W. Humber, 9, Dowgate-hl.—The permanent way of railways.
1557. T. E. Marais, Ferrières la Verrerie (Orne) France—Railway signals.
1559. W. H. Hubbard, 18, Hemus-ter., King's-rd., Chelsea—The manufacture of articles for lighting domestic and other fires.
1561. A. V. Newton, 66, Chancery-la.—Air engines.

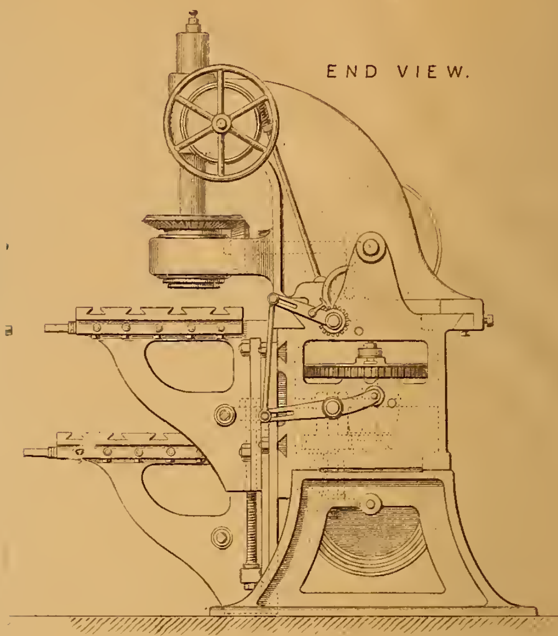
INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1410. H. G. de Chateauneuf, Paris—Improvements in apparatus for washing and bleaching clothes and other materials, to be called "The Steam Washing Lixiviateur."—14th June, 1856.
1439. C. E. Green, 13, Blandford-st., Portman-sq.—Tents, huts, and camp hospitals.—18th June, 1856.
1450. W. Radley, High-st., Peckham—Machinery, apparatus, materials, and processes for preparing and treating auriferous, argentiferous, and cupreous rocks, minerals, and alluviums, parts whereof are applicable to other purposes.—20th June, 1856.
1512. A. Ford, 35, Wellington-sq., King's-rd., Chelsea—Preparing and dissolving in naphtha or oil of turpentine, vulcanised india rubber for the purpose of waterproofing, and for all or any of the other purposes for which the same not so prepared and dissolved is now applicable, and especially for the coating of iron ships' bottoms.—27th June, 1856.
1571. T. Key, 122, Brick la., Bethnal-green—An improved knife-cleaning machine.—4th July, 1856.
1587. A. L. S. Chenot and E. C. A. Chenot, Clichy-la-Garenne, Paris—A method of extracting eliminating extraneous substances from steel sponges.—7th July, 1856.
1588. A. L. S. Chenot and E. C. A. Chenot, Clichy-la-Garenne, Paris—Improvements in sorting ores or separating metals from each other, and from certain combinations with other substances.—7th July, 1856.
1589. A. L. S. Chenot and E. C. A. Chenot, Clichy-la-Garenne, Paris—Improvements in machinery for compressing metallic sponges and other substances. 7th July, 1856.
1590. A. L. S. Chenot and E. C. A. Chenot, Clichy-la-Garenne, Paris—Improvements in apparatus for the reduction of metallic oxyds.—7th July, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.

3850. June 19. Fowler and Fry, Bristol, "Improved plough."
3851. „ 23. T. J. Shingleton, Bermondsey, "Carlton glove fastening."
3852. „ 27. J. G. Webber, 11, Charter-house-st., "The double vest, or two vests in one."
3853. „ 30. Burnley and Bellamy, Millwall, "Design for an air-tight bread tank lid."
3854. „ 30. Burnley and Bellamy, Millwall, "Design for an air-tight regulating delivery spout for iron wheat tank."
3855. July 3. Simcox, Pemberton, and Sons, Birmingham, "Sash fastening."
3856. „ 9. Tucker and Son, 100, Strand, "Indian tent lamp and packing case."



PATENT SELF ACTING

TRAVERSING DRILLING MACHINE

BY

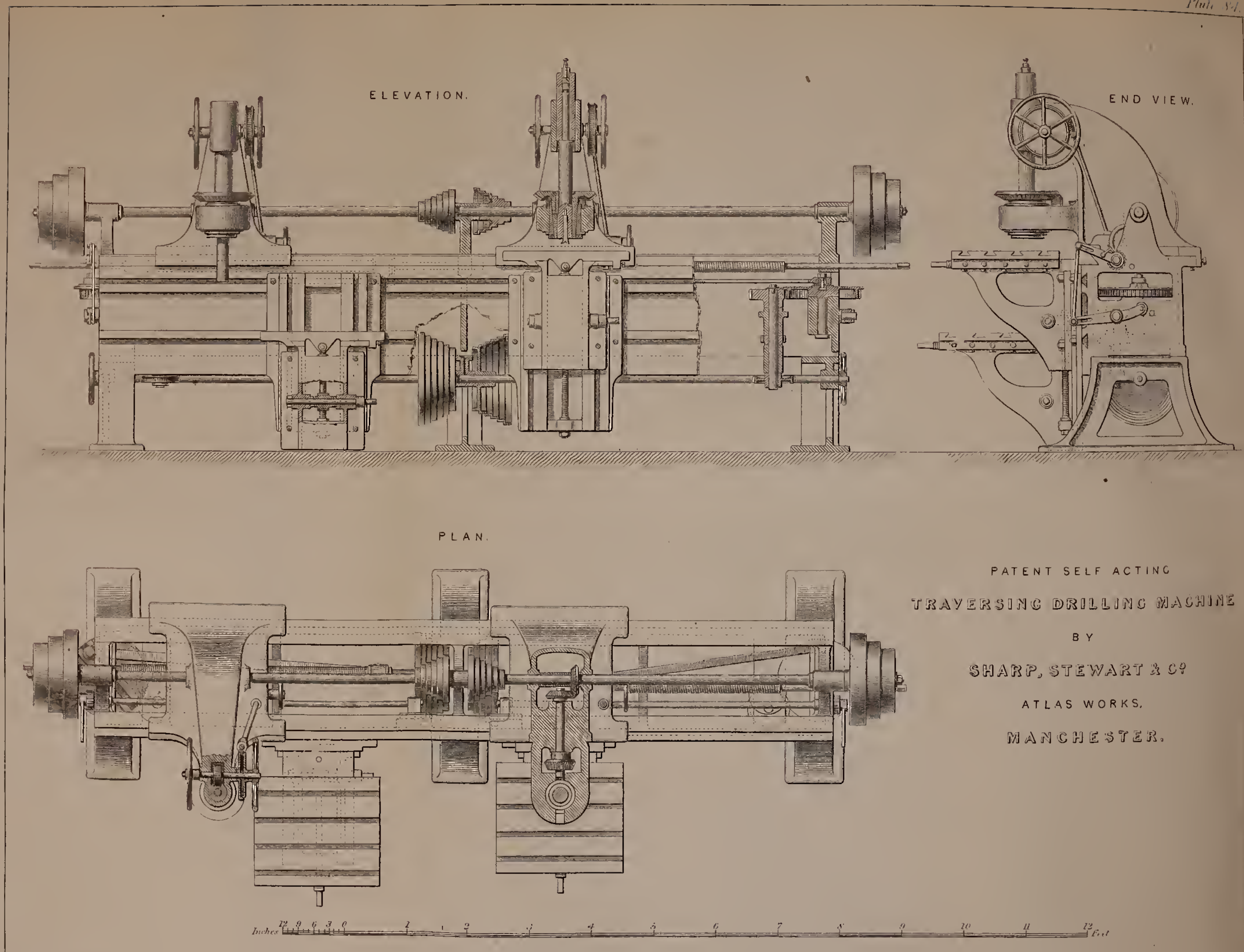
SHARP, STEWART & Cº

ATLAS WORKS,

MANCHESTER.

10 11 12 Feet.

G.B. Smith



W. Smith C.E. direxit

G.B. Smith sc

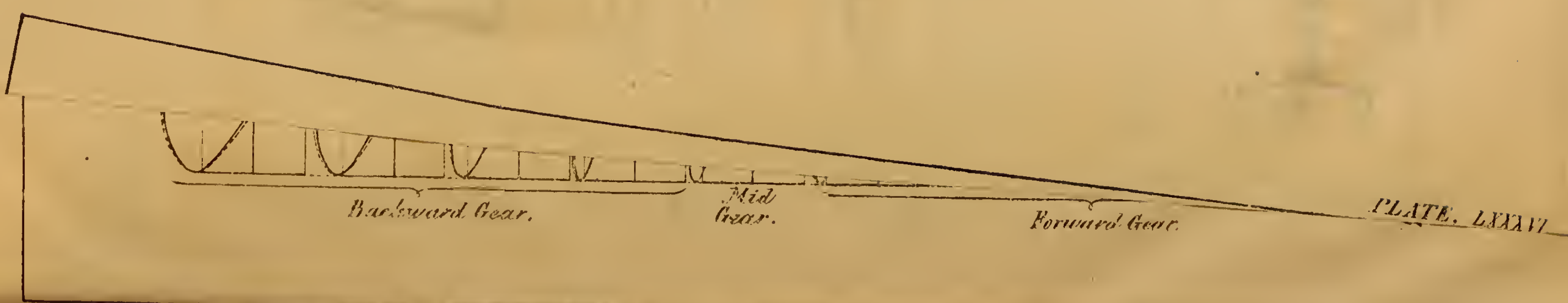


PLATE. LXXXVI

W. Smith, C.E. Direx.

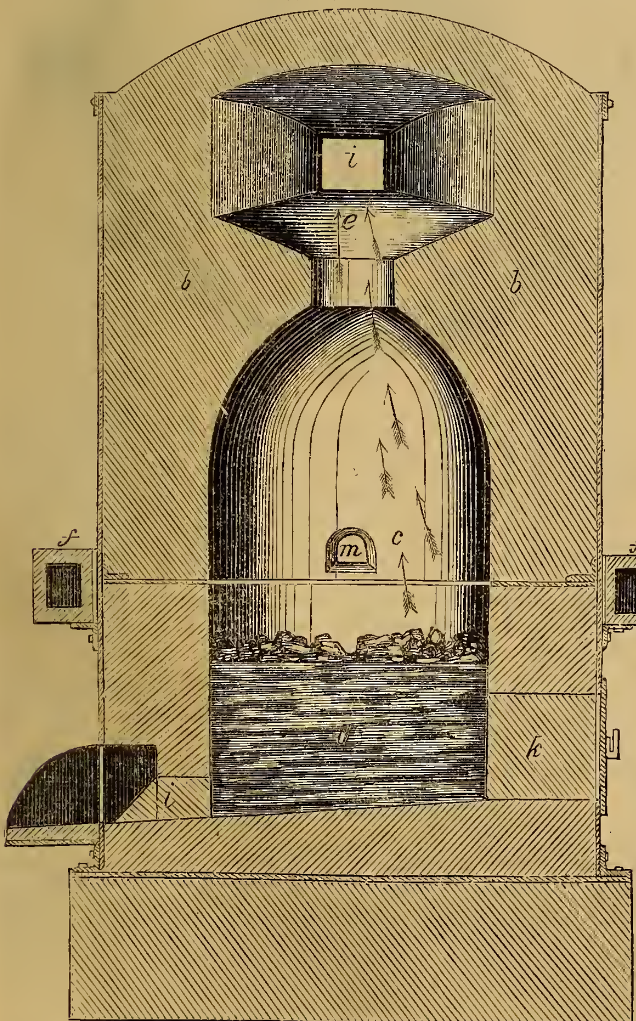
THE ARTIZAN.

No. CLXIV.—Vol. XIV.—SEPTEMBER 1st, 1856.

BESSEMER'S PROCESS OF MANUFACTURING MALLEABLE IRON AND STEEL WITHOUT FUEL.

This invention, as we predicted in our notice of it in our last Number, has excited a vast amount of interest throughout the scientific world,

FIG. 1

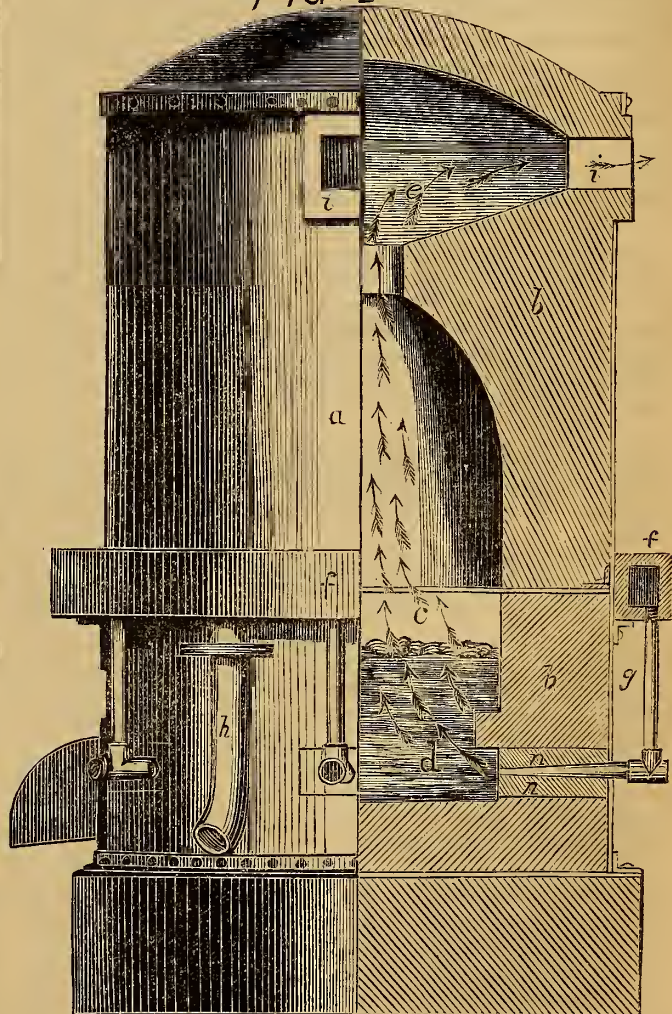


and bids fair to thoroughly revolutionise, not only the manufacture of malleable iron, but also the present system of steel making.

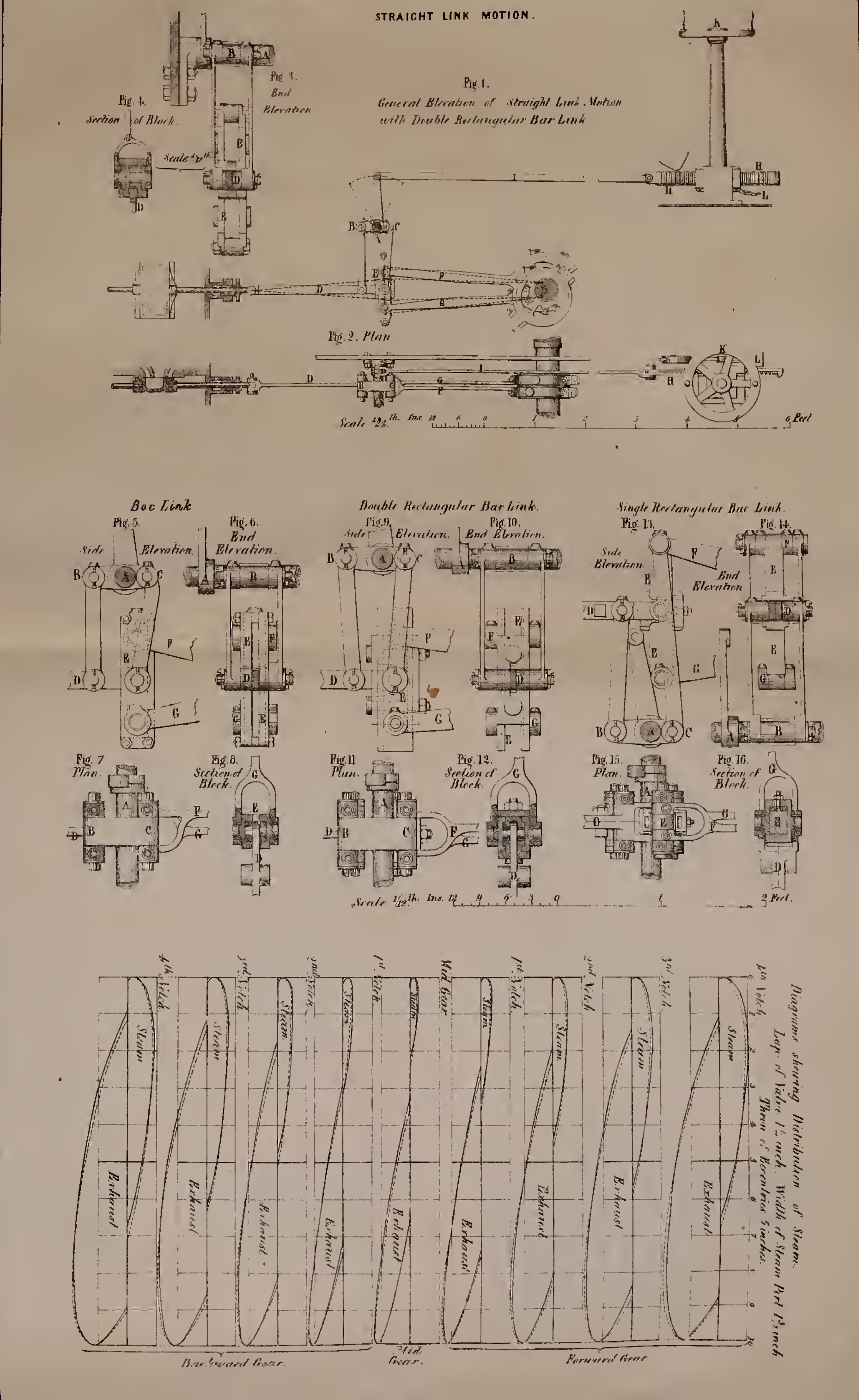
The paper upon this subject, which we have given *in extenso* in our present Number, together with the discussion and remarks by various members of the British Association, will be found well worthy of a most careful perusal. And, having been present at the whole of the meetings of section G, we are thus enabled to give the only correct report of the entire paper, and exclusively to give a report of the curious and interesting discussion which followed.

Having also witnessed the process in active operation, we are enabled

FIG. 2



to state with confidence our opinion of the simplicity and perfectly practical nature of the operation, which but requires practice to insure uniformity of results; and a series of carefully performed experiments, on a large scale, with iron of various qualities from various districts, will enable Mr. Bessemer to issue such instructions to the users of this


STRAIGHT LINK MOTION.
Fig. 1.
General Elevation of Straight Link Motion with Double Rectangular Bar Link
Fig. 2. Plan
Fig. 3. End Elevation
Fig. 4. Section of Block.
Bar Link
Fig. 5. Side Elevation.
Fig. 6. End Elevation.
Fig. 7 Plan.
Fig. 8. Section of Block.
Double Rectangular Bar Link.
Fig. 9. Side Elevation.
Fig. 10. End Elevation.
Fig. 11 Plan.
Fig. 12. Section of Block.
Single Rectangular Bar Link.
Fig. 13. Side Elevation.
Fig. 14. End Elevation
Fig. 15. Plan.
Fig. 16. Section of Block.
Diagrams showing Distribution of Steam.
Lap of Valve 1½ inch. Width of Steam Port 1½ inch
Throw of Eccentrics 5 inches.
Steam
Exhaust
Backward Gear.
Mid Gear.
Forward Gear

process as will infallibly insure perfect success in practically working it, even when in the hands of unskilled iron-workers.

How often it happens that when a great discovery is made affecting large interests, such, for instance, as those connected with the iron manufactures of this country, people are found ready to question the originality of the invention, and rake up and bring forward numerous instances of *precisely the same process* having been employed before; and sometimes bring old books on scientific subjects, written in vague and mysterious terms, to support their assertions; in the present instance, doubtless, this may also be done, for Siberia is a long way off, and so, comparatively, is Silesia; but we apprehend they are quite near enough to enable us to judge whether or not such a process was ever practised either on a small scale or at all.

We have no hesitation in affirming that no such process was ever used in connection with the manufacture of iron and steel from crude pig iron, but that a jet or blast of cold air has been employed for keeping hot the surface of metals whilst under treatment, there can be no question; for the property of atmospheric air, when projected by means of a jet or blast-pipe upon the surface of red hot iron, to maintain or increase the temperature, by the oxygen of the air, and the carbon of the iron combining therewith, is old and well known to the workers in metal, and the old nail maker—whose race is fast dying out and making way for the power-driven machine—availed himself of this property, and had affixed to his anvil-block a nozzle-pipe from his bellows, the jet of air from which was projected upon the red hot point of the nail rod, and the faster he hammered and the more cold air he blew upon the hot iron the hotter it grew, and he was thus enabled to fashion his nails with less physical labour.

The same, or somewhat similar object, directed the employment of atmospheric air blasts and jets of steam upon the surface of iron in a semi-fluid condition; but here the application stopped short, *the objects were different.*

Mr. Nasmyth's very simple but ingenious improvement, connected with the puddling and working of iron, was the introduction of steam by means of a pipe and jets in the puddling furnace; this affected the surface only of the ball or puddled mass, and enabled it to be more easily worked. And Mr. Nasmyth's observations, and Mr. Bessemer's reply thereto, which will be found in our report of the discussion, will help to explain this.

But it remained for Mr. Bessemer to drive air into the midst of a mass of crude molten pig iron, and unassociated with coal or other fuel; and the effect of this operation, with reference to the products, is very striking.

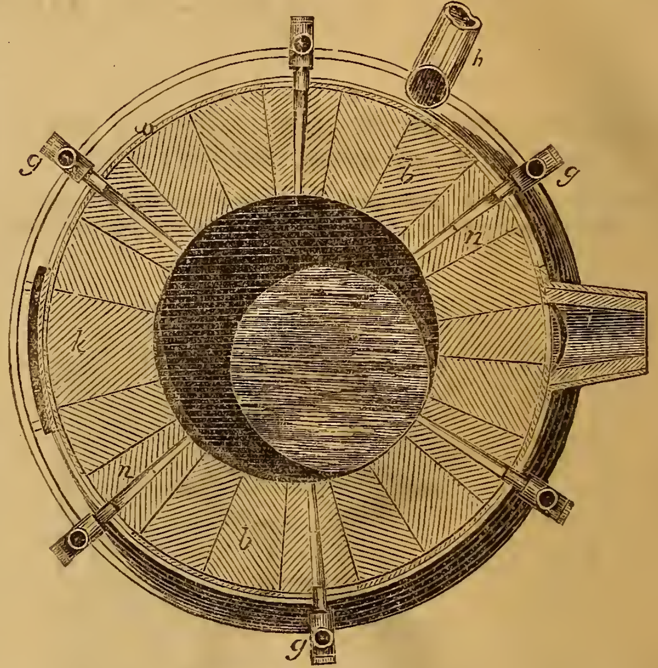
Theoretically, we have all long known the effect of the combination of the component parts of atmospheric air with carbon at a high temperature, and we have also known the relative proportions of carbon contained in various qualities of iron, and present in that metal when converted into steels of various characters; and it requires no amount of consideration to judge of the effect of bringing air into contact with the carbon present in a mass of molten metal, when the blast is driven through amongst the atoms composing the mass.

Hence it is that this process, the invention of Mr. Bessemer, has met with universal approbation; or, at least, its scientific principles have not been disputed by any of the very many practical and scientific men to whom the process has been described.

It is also worthy of remark, that in addition to the observations made by Mr. Clay at the Cheltenham Meeting, and which will be found elsewhere, the following opinion in support of our views was expressed to us by that gentleman, and which opinion we give almost *verbatim*:—

"In the manufacture of wrought iron by the present puddling process the great difficulty experienced was the obtaining of iron of a uniform quality, for the operation being entirely left to the judgment of the workman, and dependent on his skill and care, no two heats of iron, although made from the same mixtures of pig, produced iron of the same quality; in fact, even bars of the same batch or heat varied much in quality; and it is necessary, if a uniform quality of iron is required, that each bar of puddled iron be separately tested, and the various grades of quality divided. Now, instead of this uncertain process, dependent on the caprice or skill of the workman, and almost beyond the control of the iron manufacturer or manager, the new system proposed by Mr. Bessemer would emancipate the trade from such dependence, and enable the master to issue his orders that the charges of iron should be blown 25, 30 or 35 minutes, according to the quality of the pig iron operated upon, and he would, with certainty and regularity, manufacture such a quality of iron as he required. The great beauty of the process was its simplicity, and the perfect manageability of the whole operation."

FIG. 3



Practical tests, however, are always preferred by practical men, and repeated as have been the experiments of Mr. Bessemer, during several months past, and uniform as have been the results obtained by him, he has wisely determined to demonstrate the process by operating upon various qualities of iron, some of which it is impossible to work by the ordinary mode of manufacture, and with this view another exhibition of the process took place, at which an ingot of steel, weighing 6 cwt., was produced in 24 minutes, the following being a report of the experiment from our own notes, which were placed by us at the disposal of the newspaper press.

The extraordinary interest that this valuable discovery has excited since its announcement, and the reading of the paper at the meeting of the British Association, on Monday, the 11th instant, induced Mr. Bessemer to exhibit his improved process on Friday, the 22nd instant, to a select number of scientific men, amongst whom we noticed Professor F. H. Henry, F.R.S., Captain Margerson, Major Stillwell, T. J. Bramwell, C.E., A. M. Perkins, C.E., R. C. May, C.E., Wm. Smith, C.E., B. Burleigh, C.E., Messrs. R. Simpson and Joseph Robinson, of the Cwmcelyn and the Ebbew Vale Iron Works, and Mr. Baily Toms, of the Derwent Iron Company, and numerous other gentlemen connected with the iron trade.

The demonstration was made at Mr. Bessemer's works, Baxter House, Pancras-road, and the following is a brief statement of the experiment:—6 cwt. 3 qrs. 18 lbs. of molten iron, from a cupola furnace, was poured into the fire-brick vessel or apparatus, at 12 minutes past 1 o'clock, the blast having been put on at a pressure of about 8 lbs. per sq. in., and continued until 27 minutes past 1 o'clock, when the mass of metal began to boil up, and the cinder and other impurities were thrown out from the top of the furnace by two apertures, provided for the purpose. This boiling up of the metal continued for several minutes, giving off immense showers of brilliant sparks; and as the object was to produce a mass of cast steel, rather than continue the process to the extent necessary for making pure iron free from carbon, the vessel was tapped at 36 minutes past 1 o'clock, and the contents drawn off.

By continuing the process from 4 to 6 minutes more, the whole of the carbon still remaining in the mass of metal, and which gives to it that character known as steel, would have been driven off, and a pure spungy mass of crystalline iron would have been the result.

The peculiarity and important feature of this experiment is, that by the course of treatment described being continued only for a *shorter* time, that which is considerably *more valuable* as a resultant, viz., steel, of the finest quality, is produced.

When the fluid metal was tapped or allowed to run from the apparatus in which it had been treated, for a space of only 24 minutes, small specimen ingots were first taken, and the general mass was run into an ingeniously-contrived mould, concealed in the floor, in front of the tap-hole of the apparatus; and after it remained in the mould a few minutes, for the purpose of setting or cooling down, the whole mass was gradually raised out of the mould in a red-hot state, by means of an hydraulic ram, attached to the bottom of the mould, which raised up the ingot to the surface, whence it was taken, by means of slings, to a weighing-machine.

Upon weighing the ingot thus produced, together with the two specimen ingots first taken, it was found that the weight of the result obtained was 6 cwt.

Thus it will be seen that without the aid of fuel this mass of material was converted in a space of 24 minutes from crude cast iron, as it comes from the blast furnace, into steel of the finest quality, and with a gross loss of only 12½ per cent.

The average pressure of cold air employed during the experiment was 7 lbs. per sq. in.

The experiment was unanimously pronounced to be perfectly satisfactory.

The following is a description of the apparatus employed by Mr. Bessemer for the purpose of treating the molten metal according to his process :—

Fig. 1 exhibits a vertical section of a cast-iron cupola-like cylinder, the interior being built in fire-brick.

Fig. 2 is an elevation partly in section, exhibiting the construction with greater minuteness, and showing the metal just after it has been poured in and the blast turned on.

Fig. 3 is a sectional plan taken through the tuyeres ; *a* is the cylindrical iron casing of the converting vessel ; *b*, the internal lining of fire-bricks ; *c*, the lower chamber, into which the metal is poured, and wherein the boiling takes place, *d* being the molten metal ; *e* is the upper chamber, above the throat of the domed boiling chamber, *c*, and into this upper chamber, *e*, scraps, gate pieces, and other metal may be placed, and arranged round the opening, by which means the waste heat from the process of boiling is made available for melting the metal for the next charge ; *f* is an annular belt, or air passage communicating with the tuyere pipes, *g* being the tuyere pipes and nozzles ; *h* is the blast pipe connected with the blast engine ; *i i* are openings for the escape of flame and gaseous products, and from which also the eruption of slag takes place during the boil ; *j* is the tapping hole ; *k*, a man hole for cleaning out the vessel, and by which the brick lining may be repaired ; *m* is the opening through which the crude iron is run into the converting vessel ; *n n*, the fire-clay tuyere blocks, which have been found to answer better than any other arrangement, as they are easily replaceable when burnt away, or otherwise damaged.

In the course of Mr. Bessemer's experiments he discovered considerable difficulty in pouring ingots of steel free from air-holes. Now, as the value of masses of steel for all manufacturing purposes greatly depends upon their entire freedom from such defects, a suitable mode of casting ingots of steel and pure iron had to be devised by him ; how he has succeeded we will hereafter explain.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Twenty-sixth Annual Meeting.

At the meeting held in Glasgow, last year, it was determined to meet in August, 1856, at Cheltenham, and notwithstanding that Cheltenham is neither a manufacturing town, nor has it any commerce or even agricultural pursuits carried on to any extent immediately in connection with it, still it possesses the advantage of having a sufficiently extensive range of buildings of a convenient and suitable kind for the purpose of holding the meetings of the various sections, and with a separate committee room to each, under one roof; moreover, the town, as most of our readers are aware, is well built and delightfully situated, and has numerous pleasure grounds, places of entertainment, and delightful promenades within and around it, which help to compensate for the want of local interest which is generally attached to the place of meeting chosen by the Association, as, for instance, the late visit to Glasgow. It is, however, but fair to say that the following local objects of interest were open to the members.

A Museum of Local Geology was exhibited at the Literary Institution, on the Promenade. It was formed expressly for the information and recreation of the members of the British Association, and contained a complete synoptical development of the strata and fossil remains of the surrounding district.

A Photographic Exhibition, at Messrs. Hales' music saloon, and which contained betweeen 400 and 500 pictures, amongst which were a vast number of portraits, many being excellent likenesses of eminent and well-known scientific men.

The Picture Galleries of Lord Northwick, at Thirlestaine House, containing an extensive collection of paintings, and other works of art, arranged through a suite of fifteen rooms, amply repaid a visit, as also did the Collection of the Rev. E. P. Owen and T. Barber, Esq. ; and the Collection of original Drawings and Sketches by Ancient Masters, kindly exhibited by T. Bailey, Esq., at the Hall, proved of great interest to the lover of art.

The Water Works, or rather the Tanks, in which is collected the waters from the gathering-grounds immediately above them, were also worthy of a visit, the supply of water being very large and regular, and of the finest quality. It is delivered into the town without the aid of steam power, pumps, or stand-pipes, and at a pressure due to a column of from 200 ft. to 300 ft., and by which, in case of fire, water from the fire-main can be thrown over the highest church spire, and without the aid of a fire engine.

The Sewage Tanks, at Moore's Farm and Hatherly Lane, were also worth visiting, for here the sewage of the town is conveyed by three main sewers, which have been recently constructed by Mr. Dangerfield, the town surveyor ; and the experiment of converting the solid excrement and sewage matter into a fertilising compost for agricultural purposes has been most successful, and the affair is being worked with considerable profit.

The Gas Works, although possessing no very novel feature, are carried on systematically, and with great economy ; formerly they were worked by contract, but it has been found that the present system of working by the Company is much more satisfactory to all parties.

The Training College, in the London Road, and the Cheltenham Grammar School, are both educational establishments deserving of remark. The former is considered to be one of the best Normal schools in the kingdom.

Of Churches there are plenty, and of all sorts, sizes, and styles, as is usual in such fashionable places of resort, but we fancy that the student in ecclesiastical architecture would not be able to find much mental food in this locality.

Now the Spas and Gardens are delightful places, excellently well kept, particularly the Pittville Spa, which has a large and decently-architectural pump room, beautifully situated on an eminence, from which a magnificent view of the surrounding country can be obtained. It was here that the first soirée and promenade was held, on Thursday evening, August 7th.

Last, but not least, should be noticed the Cheltenham Proprietary College, as it was in the extensive series of rooms belonging to this institution that we met ; and the various sectional bodies had separate meeting rooms and committee rooms, admirably suited for the purpose, placed at their disposal.

In the two large and lofty rooms, right and left of the main entrance, section C, Geology, and section E, Geography and Ethnology, met ; the other sections met in smaller rooms, readily accessible to each other.

The proceedings of the Cheltenham Meeting commenced by a meeting of the council at 10 a.m., on Wednesday, August 6th ; and the general committee, at which the lists of sectional officers was completed, met at 1 p.m., and in the evening at 8 p.m. The president, C. G. B. Daubeny, M.D., F.R.S., &c., delivered his inaugural address, and we have rarely had the pleasure of listening to a discourse so able, full of point, and generally well suited to the occasion, as was the president's address upon this occasion. We regret that the limited space which our Journal affords prevents the possibility of our doing more than making an occasional extract from it during the progress of the proceedings of the Cheltenham meeting, which, so far as relates to the papers read, was one of the most interesting meetings which we remember to have attended during the many years that we have followed the British Association in its erratic wanderings.

We do not propose, however, to travel out of our course by giving papers read in other sections than that to which we more properly belong, viz., section G, devoted to Mechanical Science,—with the exceptions which we shall make in favour of certain interesting papers upon subjects which, although allied to our section, were read in other sections.

Moreover, we cannot promise to give in regular succession, or according to the order in which they were read, the several papers brought before section G : but we will adhere, as far as possible, to that practice, by first giving Mr. Atherton's paper, which was the first read on Thursday, the 7th of August, and which, with the discussion thereupon, occupied the time devoted to sectional business on that day.

Although the very interesting discourse delivered on Friday evening, August 8th, by Colonel Sir H. Rawlinson, F.R.S., on "Recent Discoveries in Assyria and Babylonia, with the results of Cuneiform Research up to the present time," belongs entirely to other sections than that to which we and our readers devote ourselves; still, there are points of great interest which we hope to be able, in a future Number, to bring before our readers, the more especially as Mr. James Nasmyth, C.E., gave an original and very interesting view of what he considers the "Plastic Origin of the Cuneiform character, and its relation to our Alphabet."

Of the discourse delivered by Mr. W. R. Grove, F.R.S., on his favourite subject—correlation of physical forces—we hope to be able to give an interesting and somewhat brief outline.

The attendance in each of the sections was remarkably good. The evening meetings were very numerously attended.

It is due to Mr. G. Rennie, F.R.S., the President of section G, to state that the business of the section was most ably conducted by him, and that a full and fair discussion upon each subject was permitted, whilst the time of the section was not permitted to be unnecessarily taken up.

The following address was delivered by Mr. Rennie, as President of the Section.

OPENING ADDRESS OF SECTION G AT THE 26TH MEETING OF THE BRITISH ASSOCIATION AT CHELTENHAM, 6TH AUGUST, 1856.

By GEORGE RENNIE, Esq., President.

MECHANICAL SCIENCE.

WHEN we assembled last year at Glasgow this section was presided over by Mr. W. I. Macquorne Rankine, a gentleman in every way qualified by his attainments in mathematical knowledge and its application to practical mechanics. He stated that, "although this section bears the title of Mechanical Science, it is well understood that questions of pure or abstract mechanics form no part of its subject.

"That the object of this section is to promote the advancement of science, as applied to practice in the mechanical arts.

"That on the one hand the cultivation of mechanics and other branches of natural knowledge, in a manner purely scientific, has for its object, 1st, to improve the mind of its cultivator intellectually and morally; and, 2nd, to qualify him, if possible, for assisting in the advancement and diffusion of knowledge, so that he may be able to investigate how far the laws of particular phenomena are connected with the general economy of nature and the structure of the universe. On the other hand, the cultivation of purely practical knowledge, such as is required by experience in business connected with the mechanical arts, has for its object the knowledge of materials and workmanship, with a view to their best and most economical application."

Theoretical Mechanics contemplates bodies in an immaterial sense, subject to the laws of equilibrium and motion; and *practical mechanics*, the properties of materials in their solid, fluid, or gaseous states, subject to the same laws; so that while the *science* of mechanics has attained its limits of perfection, its application to the material world is yet very limited. The main object in every inquiry, therefore, is by an analytical process, to separate the various effects which nature has blended together, and to reduce the number of principles to ultimate facts.

Every extension of the powers of calculation, every addition to our stock of knowledge, however small, and apparently unimportant, in the properties of materials; every improvement in the most simple machine, is a prelude to further advancement towards mechanical perfection.

The philosophy of machinery, or of its application to manufacture, is therefore an exposition of general principles on which productive industry now denotes every extensive product of art which is made by machinery, with little or no aid from the human hand, but entirely conducted by self-acting machines. "The end of manufacture," says Dr. Ure,* "is to modify the texture, form, or composition of natural objects by mechanical or chemical forces acting separately, or combined, or in succession."

Hence, the automatic arts, which are subservient to general commerce, may be distinguished either as mechanical or chemical, according as they modify the external form or internal constitution of their material elements.

The constant aim and tendency of every improvement in machinery is to supersede human labour, and thus diminish the cost of production by substituting feeble and unskilful labour for that of skilful artizans; and although we are not yet arrived at that state of perfection when it can be dispensed with entirely, the great bulk of our enormous annual productions is the result of automatic labour.

The man of science, continues the same author, in his philosophy of machinery, pre-occupied with theoretical "formulæ of little practical bearing, is too apt to undervalue the science of the factory, though, with candour and patience, he would find it replete with useful applications of the most beautiful dynamical and statistical problems. In physics, he would then see many theorems bearing golden fruit, which had long been barren ground; the phenomena of heat in particular, investigated in their relations to matter in all their varieties."

The measure of temperature on every "scale is familiar to the manufacturer, as well as the distribution of caloric and its habitudes with different bodies—the production of vapours—the relation of their elastic force to their temperature—the modes of using as instruments of power and sources of heat—their most effective condensation—their hydrometric agency—may all be better studied in a week's residence in Lancashire than in a session of any university in Europe; and as to exact mechanical science, no school can compete with a modern cotton mill."

Improvements in machinery, therefore, have a threefold being:—

1st. They make it possible to fabricate some articles which, but for them, could not be fabricated at all.

2nd. They enable an operative to turn out a greater quantity of work than he could before—time, labour, and quality of work, remaining constant.

3rd. They effect a substitution of labour (comparatively unskilled) for that which is more skilled.

The object, therefore, of manufactures is to modify the productions of nature into articles of necessity, convenience, or luxury, by the most economical and unerring means—mechanically, morally, and commercially—*i. e.*, by labour, science, and capital. The first to move, the second to direct, and the third to sustain when the whole are in harmony, to form a body qualified to discharge its manifold functions by an intrinsic self-governing agency, like those of organic life.

"The man of science," said the late Professor Robinson,* "who visits our great manufactories is delighted with the ingenuity which he observes in every part. The innumerable inventions which come even from individual artizans, and the determined purpose of improvement and refinement which he sees in every workshop, every cotton mill appears an academy of mechanical science and mechanical invention, from these fountains—even the whole kingdom. But the philosopher is mortified to see this ardent spirit so cramped by ignorance of principles, and many of these original and brilliant thoughts obscured and clogged with needless, and even hurtful additions, and a complication of machinery, which checks improvement by its appearance of ingenuity. There is nothing in which this want of scientific education—this ignorance of principle—is so frequently observed as in the injudicious proportion of the parts of machines and other mechanical structures."

If these were his opinions half a century ago, what would he have said, if he had been awakened from his grave, to witness the vast and wonderful progress which mechanical knowledge has since attained.

He would have seen the doctrines so clearly laid down by himself, in his papers on the strength of materials, the equilibrium of structures, and the exposition of the steam engine, illustrated by Watt, largely extended in every department.

The unobtrusive inquiries into the forge and the furnace, by a Cort and a Mushet, a Neilson or a Crane, and we may now add a Bessemer, pioneers whose labours have added so largely to the resources of their country. He would have seen the properties of the materials so produced investigated in all their varieties by a Hodgkinson and a Fairbairn, and others, all labouring in the same vineyard; and those materials again applied in every form of mechanical combination, whether propelled by animate force or by the all-pervading powers of heat. Again, in the equilibrium of structures, he would have witnessed the balanced arch, the rigid beam, or the suspended chain, or the graceful ship and rapid locomotive—all subjected to the mechanical laws so amplified by himself in their application to the innumerable wants of man. The influence of retarding forces, such as *friction*, developed by so many experiments as to render our knowlege of this subject almost perfect. The motion and equilibrium of fluids, and their application to hydraulic machines of every description.

The effects of chemical as well as mechanical combinations, would have suggested many applications of heat to the expansion of fluids and gases, and of the wonders performed by that subtle fluid denominated voltaic, which has hitherto baffled all our researches, but which seems, to our feeble senses, the source of light and life.

All these are the results of experiments guided by science—a science which musters among its cultivators the names of the most illustrious of the past and present centuries, and from which it would be almost invidious to select further than the acknowledgment due to a Black, a Watt, a Robinson, a Rumford, a Dalton, an Airey, a Babbage, a Brewster, a Moseley, a Whewell, a Willis, a Joule, and a Thompson, as those who have advocated the cause of mechanical science in our own country; on an Arago, a Dulong, a Poncelet, a Morin, and a Regnault, and a Hess, of the Continent. All these philosophers have been powerfully aided by the practical engineers, whose labours have contributed largely to their researches, and to whom this country, as well as science in general, has been so largely indebted.

* Philosophy of Manufacture.

* System of Mechanical Philosophy, 4 Vols. Edited by Brewster.

ON MERCANTILE STEAM TRANSPORT ECONOMY.

A Paper read by Mr. Charles Atherton, Chief Engineer of Her Majesty's Dockyard, Woolwich, at a Meeting of the British Association, held at Cheltenham, 7th August, 1856.

The construction of ships and the administration of shipping affairs, involving a multiplicity of considerations of a scientific and of a practical and mercantile character, connected with these arts, requires that shipping direction be regarded and treated as the subject of an exclusive science; and, of late years, the progressively extended application of steam to maritime purposes, and the prospect of its general use as an auxiliary power, have still further complicated the subject, and extended the range of mechanical acquirement which is now necessary in the prosecution of steam-ship equipment, direction, and management. It is, therefore, with diffidence, and with the feeling of my not possessing the combination of qualifications which is necessary to ensure adequate justice being done in all respects to the elucidation of the important subject, "Steam Transport Economy," that I enter upon the task of bringing that subject before the notice of the British Association for the Promotion of Science. I am, however, encouraged by the assuring reflection that public utility is a field in which it is an honour to labour, that lenient consideration for individual deficiencies and the helping hand of others will be extended to the most humble delvers in that field, and that credit may be earned in proportion to the roughness and obdurate nature of the spot of ground which we may have undertaken to break up, and to the perseverance by which one may at least attempt the accomplishment of the assigned task. Permit me, therefore, to remark, that my present appeal to the British Association is but a continuation of my previous efforts in the cause of steam exposition, with a view to bringing "Steam Transport Economy" within the pale of arithmetical calculation; and as I shall have occasion to refer to the enunciation of principles, and to the details of calculations which have thus preceded this essay, it may be convenient that I briefly enumerate the various published statements thus referred to as forming an integral portion of this paper, and which, accordingly, I beg to hand in to the Association for the purposes of reference and record.

1st. A brief essay on "Marine Engine Construction and Classification," published by Weale, in 1851.

The object of this essay was to analyse the data afforded by published and authentic statements of the actual test-trial performances of various steam-ships, and ascertain, by means of such comparative analysis, what are the peculiarities or proportions of build, and what are the peculiarities of engine-construction of those vessels which have attained to the highest degrees of locomotive efficiency, thereby also scrutinising how far the popularly-received notions in regard to steam-ship type and marine engine construction, supposed to be most conducive to locomotive efficiency, may be in accordance with, or opposition to, the results of actual experience, when measured by any definite and received law.

2nd. An essay on "Steam-ship Capability," originally published in 1853, and of which a second edition, with supplement, was published by Weale, in 1854.

This essay was designed to demonstrate the mutual relations which subsist between displacement, power and speed in steam-ships, especially as respects the increasing scale of engine-power by which progressive increase of speed is attained; and to show the difficulties which attend the prosecution of a steam service, in which long passages are required to be performed at a high rate of speed; also to show the sacrifice which attends the employment of vessels of an inferior type of build, as compared with vessels of a superior type. The supplement published with the second edition of this essay extended the tabular calculations to embrace vessels of hypothetical magnitude, and to demonstrate a system of £ *s. d.* arithmetical calculation applicable to estimating the cost of goods conveyance per ton weight by steam-ships, based on the constructive type of the ship, the speed to be realised, and the size of ship employed to do the work. The appendix to this essay embraces a dissertation on the probable capabilities of ships of unprecedented magnitude, showing the advantage of magnitude so far as mechanical principles are concerned, irrespective of mercantile considerations, and under what combinations of speed and distance without re-coaling, comparatively with the more frequent coaling depôts available to smaller vessels, the mechanical advantage of magnitude becomes neutralised; it also gives new tables for facilitating steam-ship calculations, by showing the cubes of numbers from 5 to 25, rising by the decimal ·01, and the cube-roots of the squares of all numbers likely to be embraced in the tonnage displacement of ships.

3rd. A paper on "Steam-ship Capability," read before the Society of Arts, London, 16th May, 1855.

The object of this paper was to expose the indefinite nature of the terms "horse-power" and "tonnage" as respects their not being what they are generally supposed to be, definite units of measurement of engine-power and ships' size, also to show the uselessness for scientific purposes of all statistical data based on nominal horse-power and nominal tonnage, and the fallacy of all calculations based on those indefinite terms, thence showing the necessity for some definite measure of power being legalised as the unit of power to be denoted by the term "Marine Horse-power," and used as the base of calculation and contract engagement in steam shipping affairs.

4th. A paper on "Tonnage Registration," read before the Society of Arts, London, January 16, 1856, with the discussions thereon.

The object of this paper was to show the insufficiency for scientific purposes of the system of Tonnage Registration now in force, as prescribed by the Merchant Shipping Bill of 1854, in so far that under this Act the registered tonnage of a ship affords no certain indication of the tons weight of cargo that the ship will carry, nor does it give, even approximately, the displacement with reference to any given draught, nor does the registration afford any indication of the power capable of being worked up to by the engines of steam ships, or any other data whereby the dynamic properties or locomotive duty of vessels may be scrutinised on scientific principles. By this paper, I brought forward certain suggestions for public consideration and discussion, with a view to our official registration of shipping being rendered more comprehensive for the fulfilment of the various useful purposes to which statistical registration, if complete, would undoubtedly conduce, in a scientific point of view, irrespectively of merely fiscal objects.

These papers, of 16th May, 1855, and 16th of January, 1856, urging the establishment and recognition of definite units as the legal admeasurement of marine engine-power and ships' tonnage, I beg respectively to submit to the notice of the Committee appointed by this Association for the consideration of the tonnage question, of which Committee I had the honour of being named a member, but I was under the necessity of declining to take part on this Committee in consequence of my being, as above stated, committed to certain views, and publicly engaged in agitating the question of Tonnage Registration amendment, with a view to supplying the deficiencies of the present system.

Having thus shown that various investigations essentially connected with the elucidation of the subject now before us, "Steam Transport Economy," have constantly and publicly engaged my attention since 1851, I may now, in the beginning of my paper, announce the proposition to which I hope to direct the attention of the British Association.

Now, what I have undertaken to demonstrate is this—that, in consequence of there being no *legalised* definitions of the terms power and tonnage as standard units of quantity applied to the prosecution of steam navigation, there is practically no *definite* measure of quantity whatever attached to those terms, even although they are so generally made use of as the base of pecuniary contracts, and that, in addition to the private evils as between buyer and seller resulting from this singular anomaly in matters of mercantile account, the public evils resulting from nominal "horse-power" and "tonnage" being terms which cannot be scientifically recognised as expressing either the working power of marine machinery or the size of a ship, are monstrous, inasmuch as they publicly defeat science from being brought to bear on steam-ship construction and steam-ship management as a means of investigation and proof, whereby to confirm the existence and establish the continued adoption of good practice where good practice does exist, and to detect error, either in the construction of steamers or in the management of steamers, in cases where bad types of construction and maladministration may exist and be destructive of enterprise, which might otherwise have conduced to public good. In short, my object is to show that in consequence of the deficiencies in our national standard units of power and tonnage, and deficiencies of our statistical registration, the public are deprived of the benefits capable of being derived from science as a means of discriminating between good and bad practice in the great matter of shipping, thus enabling us to take advantage of the one and explode the other. The constructive merits of steam-ships in a dynamic point of view may be comparatively determined by the ratio that subsists between the amount of displacement that is propelled from place to place, the speed or time in which the vessel performs the given passage, and the engine power exerted or the coal consumed in the performance of the work; yet every ship that is launched and goes with flying colours upon the usual test-trial, is always, for the day, pronounced to be the most wonderful ship that ever was built, and no wonder that it is so, considering that the dynamic merits of ships are thus determined, not by any admitted rule based on the mutual relations of displacement, power and speed, but by acclamation, based on the mutual interests of all concerned, that a new ship shall be of good repute. All attempts to expose this monstrous deficiency in our nautical system by urging the importance of statistical registration, have been held up to reprobation as an interference with the shipping interests, regardless of the fact that it is the public who pay the penalty of an enhanced price of goods' transport consequent on whatever deficiencies may exist in connexion with the locomotive properties of our shipping.

In justification of these remarks as to our denominations of ships' tonnage and engine-power being a delusion, subversive of all truth so far as scientific inquiry and research may be based thereon, I may be permitted to adduce the following statements:—

1st. As to tonnage registration. Although tonnage measurement for registration has been subjected to legislative revision under the Merchant Shipping Act of 1854, the term "tonnage" is still made use of in various significations. By the present law, 100 cubic ft. of internal roomage, or available space for cargo, constitutes the unit of tonnage, but as respects all ships built previously to the month of May, 1855, when this Act came into operation, the adoption of this law is not compulsory. Merchants have the privilege of retaining the former registration of some ships, and getting such others of their ships measured and registered under the new Act as they may think fit to select for re-registry, so that the term tonnage may now signify "builders' tonnage," old measure, under the Act of 1773, or tonnage under the Act of 1833, or tonnage under the Act of 1854, and these are three totally different systems of admeasurement, having no definite ratio to each other. Moreover, the unit of tonnage under the Act of 1854 being based on internal roomage *measuring up to the deck*, affords no certain indication of the displacement of a ship when loaded fit for sea, nor does it afford any assurance whatever as to the tons weight of cargo that a ship will carry; for example, by adopting the cellular principle of build now introduced in the construction of iron ships, a ship of 10,000 cubic ft. of internal roomage, or 100 tons register tonnage, may have such external displacement as would safely float with the whole internal roomage filled with iron, and therefore weighing no less than 1,000 tons of dead weight, or ten times the register tonnage, and the registration of steam-ships is open to similar delusion as to their capability for weight of cargo. So much for the mercantile liberties that may possibly be introduced, and taken with our statistics of exports and imports, so far as they may be based on the tonnage registration of shipping under the Act of 1854.

The abortiveness for statistical and scientific purposes which has hitherto attended all legislation on tonnage registration, appears to have been occasioned by the attempt to embrace under the one term, "tonnage," two things, which have no fixed ratio to each other; viz., tonnage by bulk, and tonnage by weight. The law has not comprehended the double mercantile use and application of the term "ton," by providing for the separate and distinct registration of each, namely, tonnage by bulk and tonnage by weight, the capability of ships for bulk tonnage being dependent on internal roomage, but the capability of ships for weight tonnage being dependent on external displacement, a distinction which is not noticed by the new law of tonnage admeasurement under the Act of 1854.

2nd. As to marine engine-power. Although Watt originally defined the unit of power, which he denominated horse-power, as equivalent to 33,000lbs. weight raised 1 ft. high in 1 min. of time, and invented a mechanical device or instrument called a "steam indicator," whereby the variable pressure of the steam in the cylinder, and consequently the working power of steam-engines, could be readily ascertained (whence the working power so ascertained was denominated the "*indicated* horse-power"), all which arrangements of Watt put the working operation of the steam-engine originally on a scientific base, defined by a standard unit of power admeasurement, still this definite unit of power was never recognised by law, and consequently the steam-engine was no sooner applied to maritime purposes than the rivalry of trade induced a practice under which the nominal, or contract power of engines, did not specifically regulate the working capability of the engine delivered. Engines were not objected to by the purchaser if their working capabilities were in excess of the nominal power, and engineers themselves voluntarily supplied marine engines working up to an "*indicated*" power far in excess of the "*nominal*" power, for the purpose of thereby driving the new vessel at a higher rate of speed than that attained by some rival vessel with the same nominal power. Reputation for the production of fast steamers depended on beating the rival boat, not on the mode of effecting that object. The shipping interests and their working craftsmen, shipwrights and engineers, felt themselves constrained to meet their rivals in trade with their rivals' weapons; numerous devices have been adopted with a view to the development of power on board of ship by packing the greatest amount of engine-power into the least space, and undoubtedly great improvements have been made by adapting the dimensions and proportions of vessels to the service required, but still "Fame," in regard to the character of steam-ships based on speed, has been too much the result of horse-power delusive jockeyship rather than of truthful science. By the practice of trade, horse-power came to be measured by the diameter of the cylinder, without any limitation as to the capabilities of the boiler, and gradually in time a marine-engine contract was considered not to be fulfilled unless the engines were capable of working up to an "indicated horse-power," at least double that of the contract nominal power; still, however, no specific limit was assigned either by custom or by law, and, at length, to such a degree has competition set truth at defiance, that the working, or "indicated horse-power" of engines delivered under contract has frequently amounted to four times the nominal horse-power actually stipulated for by the contract. These facts are fully set forth in the Paper read by me before the Society of Arts on the 16th May, 1855.

Having thus pointed out the indefinite application in steam shipping practice of the terms "tonnage" and "horse-power," with reference to the definite terms "displacement" and "indicated horse-power," it may be still further edifying that we illustrate the anomalies liable to result when these terms are used in combination with each other, as is constantly the case in expressing and recording the ratio of tonnage to power of a steam-ship. In exposition of this matter, I may again refer to the before-mentioned paper, whereby it will be seen that I selected ten vessels, in each of which the ratio of builders' tonnage to nominal power was very nearly the same—viz., in the ratio of 100 tons of builders' tonnage to 40 nominal horse-power, or 2½ tons of tonnage to 1 nominal horse-power; but on comparing the constructors' load displacement of these same ships, calculated in tons weight, at 35 cubic ft. of water to the ton, with the *effective* working power, based on indicator measurement, the ratio was found to be 100 tons displacement to 38 horse-power in one case, and 100 tons displacement to 281 horse-power in another.

The recorded statistics of these ten vessels would lead one to infer that they are all powered in the same proportion of engine-power to size of ship: but, in fact, they are all different, and on comparing the two extremes, one ship has no less than seven times the power of the other, in proportion to size of ship as determined by displacement. In fact, generally, the records of register-tonnage and nominal horse-power do not constitute statistical data of any value whatever for the scientific purpose of discriminating between the relative dynamic merits of steam-ships; but, on the contrary, such records, and all ideas resulting therefrom, are positively delusive and mischievous. The conclusion at which I would arrive from these statements is, that the very first step in any attempts to bring steam affairs within the range of arithmetical calculation must necessarily be to establish the measure or value which we assign to our units of tonnage and power. It is only by the moral influence of such a body as the British Association that the cause of science can obtain a hearing in this matter of statistical registration applied to shipping. With reference to our units, it is, of course, desirable that the measure of the unit, to be legally recognised as the unit of power, should be nearly in accordance with the general average of practice at the time when the unit may be so established; and as at the present time (1856) the general run of marine nominal horse-power varies from two indicated horse-power to four indicated horse-power—that is from 66,000 lbs. to 132,000 lbs. raised 1 ft. high per minute, it is submitted that the unit of marine horse-power would now be most conveniently fixed at 100,000 lbs. raised 1 ft. high per minute. Until, however, some definite measure of the unit be legally recognised it is considered advisable, in matters of scientific inquiry like the present, to adhere to the measure of the unit originally proposed by Watt—viz., 33,000 lbs. raised 1 ft. high per minute, designating this scale of measurement as the "indicated horse-power," thus :—Ind. h. p.; and such will be the unit referred to when horse-power is spoken of in the following pages of this paper.

Now, as to the measure of the unit of tonnage by which the sizes of ships are to be spoken of and compared, we have already observed that under the Merchant Shipping Act passed in the year 1854, the unit of tonnage is based on the internal roomage of ships available for cargo; that all ships built since May, 1855, are registered under this Act; but the re-measurement and re-registration of ships built previously to 1855 is not made compulsory. Shipowners have the privilege of re-registering, under the Act of 1854, such vessels as they may select for that purpose; consequently, our present registration is mixed, and the various units of tonnage-measurement thus embraced under our present tonnage-registration have no definite ratio to each other, or to the tons' weight of cargo that ships will carry. The comparative merits or demerits of these various systems of registration for *fiscal* purposes need not be here discussed; suffice it to say, that in none of these systems has any notice whatever been taken of the measurements which constitute displacement; and as displacement is an essential element in any scientific investigation as to the locomotive performance of steam-ships, with reference to the power employed and speed attained, it follows that our present registration of shipping, even under the Act of 1854, does not afford statistical data of such a character as to be available for science in the matter of comparing the merits, in a locomotive or dynamic point of view, of the various models or types of form by which steam-ships have been constructed. It is submitted for the consideration of the British Association that national advancement in maritime affairs, especially in regard to transport economy, would be promoted by our public registration of shipping in general, and of steam shipping in particular, being so systematised as to embrace, not only the roomage measurement required for fiscal purposes, but also, in addition, those details of *displacement* which, in combination with the data of speed and power derived from the actual performances of ships, are necessary to scientific investigation in determining the relative dynamic merits of different types of form of steam-ships. It must be borne in mind that it is the public—the consumers of merchandise—who must ultimately bear all the expenses connected with the transport and delivery of merchandise, whether well or ill performed. Bad ships individually enhance the average cost of imported corn and all other consumable merchandise. Bad ships also enhance the price of cotton and all other similar raw material imported for the production of export manufactures. This enhanced price restricts demand, thus curtailing the sources of employment, so that every bad ship, whether employed in the import or export trade is, of itself, a public nuisance; a prevalent bad type of ships would be a public calamity, and progressive improvement would be a public benefit. It has been said that the interests of shipowners is in itself a sufficient guarantee for insuring the adoption of the type of ships best adapted for mercantile steam transport economy. It is scarcely fair to base any argument on interested motives, but as that argument has been raised it must be noticed. Undoubtedly, each shipowner has an individual interest in his own ships being the best afloat; but if he does possess the best ships, it is equally his interest to keep that fact and the means of acquiring them to himself, so that the charges for freight may continue to be ruled by the inferior dynamic qualities of the average ships employed by the trade, not by the superior dynamic qualities of the best ships as possessed by himself; the difference being the shipowner's private advantage or the public's loss. It is, therefore, the interest of the public that all bad types of shipping be exposed and eradicated. Freight would then, as respects the quality of ships, be ruled by a scale of charges derived from the performance of a generally improved type of ships working in fair competition with each other.

Having already defined the measurement of the units by which we propose to designate the working power of the engines and the size of the ship—viz., indicated horse-power, at 33,000 lbs. raised 1 ft. high per minute, and tons weight of displacement at 35 cubic ft. of water to the ton, it is now necessary that we refer to the received law or formula by which the comparative dynamic duty of steam-ships may be numerically ascertained. The formula usually adopted for obtaining the co-efficient of dynamic duty of steam-ships is $\left(\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}} = C\right)$ in which D is the displacement of the ship at the time of trial, expressed in tons weight, V; the speed (usually expressed in nautical miles per hour) and indicated horse-power, the working power as ascertained by means of the indicator. The resultant number, C, deduced from this formula, is termed the co-efficient of dynamic performance. This co-efficient, C, will be a constant number for all vessels of perfectly similar model or type of form, and of which the engines are equally effective in proportion to their gross indicated horse-power; but if the vessels be not of similar type, and the engines not equally effective in proportion to their indicated horse-power, the co-efficient, C, will vary, and thus the dynamic performance of different vessels will be *comparatively* classified. It is not our purpose in this paper to raise any question as to the scientific rationale or resultant accuracy of this formula; I will merely observe, that though open to criticism in several respects, the results of experience have demonstrated that this formula, when applied to any known type of ship, expounds the mutual relations of displacement, power, and speed, with a degree of precision that admits of its being practically made use of for determining the resultant speed that is to be expected from any combination of power and displacement; and, in like manner, any of the three elements of the formula may be deduced from the other two being given. Further, this formula may be rendered available as a counting-house check on the working operation of steam-ships, simply by substituting the consumption of coals, expressed in cwts. per day of 24 hours (W), in lieu of the indicated horse-power; for 1 cwt., or 112 lbs., per day of 24 hours, is at the rate of 4·66 lbs. per hour, which is probably about the ordinary consumption per indicated horse-power per hour, and it ought not to be exceeded. If, therefore, in lieu of the indicated horse-power, we substitute the consumption of coals, calculated in cwts. per day of 24 hours, the resultant co-efficient (C) will afford an approximate indication of the good or bad performance of ships, as compared one with another, and the fact of an inferior performance being thus detected, the cause to which it may be attributable, whether to inferior type of form or foulness of bottom, or inferior adaptation of engine, or inferior construction of boiler, or inferior management on board ship, will then become the subject of professional inquiry; thus the merchant, by aid of his counting-house statistics of displacement, time on passage of given length, and coals consumed, will be enabled to detect the fact of inefficiency, and it will then be for the professional engineer to detect and remedy the cause thereof. The annunciation of the formula, or the mercantile rule above referred to, is as follows:—Multiply the cube of the speed, expressed in knots or nautical miles per hour (V^3), by the cube root of the square of the displacement ($D^{\frac{2}{3}}$), and divide by the consumption of coals, expressed in cwts. per day of 24 hours, the resultant numeral co-efficient (C) will indicate the dynamic or locomotive efficiency of the vessel; and, such is the variable condition of steam-ships in present use, that the co-efficient has been found to be as low in some cases as 120, whilst in other cases it has reached the number 250. The pecuniary value of gold is determined by assay; and in like manner the contract price to be paid for a steam-ship should, in some measure, be regulated by the co-efficient, based on the mutual relation of displacement, speed, and coals, which may be realised on trial of the ship; for example, multiply the contract price by the numeral co-efficient that may be actually realised, and divide by the co-efficient that may be regarded as the *par* measure of dynamic efficiency, according as the vessels may be painted or sheathed with copper. Contracts based on this principle would constitute a check upon the production of inefficient ships, and award a premium on the construction of ships of superior merit.

The approximate trustworthiness of the formula $\left(\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}} = C\right)$ being conceded, we now have the means of pursuing our exposition of the extent to which any definite difference of type or falling off in the working condition of a ship will affect the amount of prime cost expenses incurred in the conveyance of merchandise by steam-ships. Suppose, for example, that we have ships whose co-efficients of dynamic duty or index numbers (C) deduced from the formula $\left(\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}} = C\right)$ are respectively 250 and 166, which numbers correspond with 1,000 and 664, if the unit of marine engine-power be taken at 4 indicated horse-power, as is the case in the tabular calculations given in Atherton's "Steam-ship Capability," and are co-efficients of dynamic duty not unusual as between different steam-ships in actual practice; in evidence of which, confirmatory of the official records whence these numbers are taken, I may refer to a tabular statement of steam-ship trials recently supplied to me by one of our most experienced firms (engineers and shipbuilders), by which statement it appears that, adopting the formula referred to, the index numbers or co-efficients of dynamic duty of eight steam-ships varied from 251 to 149, thus showing that the difference of constructive types now assumed as the base of calculation for this exposition, is not an exaggeration, but such as is common in practice. In the first place, referring to "Steam-ship Capability," 2nd edit., page 78, we will expose the difference of power (indicated horse-power) which would be required by two vessels, A and B, of the respective types of working conditions of service indicated by the co-efficients above referred to (namely 250 and 166), supposing the vessels to be each of 2,500 tons load displacement. The vessel, A, will be propelled at 8 knots, 10 knots and 12 knots per hour, by 376 indicated horse-power, 736 indicated horse-power, and 1,272 indicated horse-power; but the vessel, B, will require, to attain the same rate of speed, 568 indicated horse-power, 1,112 indicated horse-power, and 1,920 indicated horse-power. Thus the ship, B, requires, in consequence of her inferiority of working condition, or type of construction, an increase of power of no less than 50 per cent. in order to attain the same rate of speed as ship A; and, be it observed, that these assumed co-efficients are within the range of ordinary difference between one ship and another.

We will now show the sacrifice which such a difference of type produces in the weight of cargo which these ships of (say) 2,500 tons displacement, with mean quantity of coal on board, would respectively carry on a given passage, if powered for running at the speed of 8, 10 and 12 knots per hour. For this exposition we will assume the weight of the ships themselves, as measured by the light displacement of ships, when ready to receive cargo and coal for the voyage, to appropriate 1,000 tons displacement, being 40 per cent. of the load displacement. We will also assume the weight of the engine department complete at 5 cwts. per indicated horse-power, and the consumption of coal to be at the rate of 4 lbs. per indicated horse-power per hour, and the length of passage, without re-coaling, to be 3,250 nautical miles, being about the distance from Liverpool to New York, or to Constantinople. On these data, according as the vessels may be powered, as before shown, for being propelled at the speed of 8, 10 and 12 knots per hour, the displacement available for cargo, in A, will be 1,270 tons, 1,103 tons and 875 tons' weight of cargo; while, in B, it will be 1,152, 900 and 556 tons weight. The consumption of coal, in A, will be 273 tons at 8 knots, 427 tons at 10 knots, and 615 tons at 12 knots; and, in B, it will be 412, 645 and 929 tons weight. Hence it appears that purely in consequence of the difference in constructive type, or working condition of the ships, the reduction of cargo, in B, as compared with A, will be 9, 18 and 36 per cent., according as the speed may be 8, 10 or 12 knots per hour; while the increase of coal, being in proportion to the increase of power, will, in each case, be 50 per cent. But the public evils of an inferior type, or neglected condition of ships, will be still more fully exposed and be more definitely understood by the extra £ *s. d.* charge that must be made for freight per ton weight of goods, conveyed in order to meet the prime cost expense of conveyance. In order to work out this calculation, we must assume certain data of investment and current expense as constituting the prime cost charges of permanently establishing and upholding a commercial fleet of steam-ships; and as this is the vital point in which the public, as consumers, have a direct interest, it will be expected that I enter upon it in considerable detail, as set forth in supplement to "Steam-ship Capability," 2nd edition, page 76.

In the first place, I would remark that it is only during the number of days that steamers are annually at sea, conveying cargoes of goods from port to port, that they earn the income that is to defray the whole annual expenditure incurred. The number of days per annum during which steamers are at sea will, of course, depend materially on the service in which they may be employed; and, as it is proposed to work out our calculations with reference to a passage of 3,250 nautical miles—such, for example, as the passage from England to New York, or to the Black Sea—I have assumed that the vessels employed on such service may be at sea 200 days per annum. In the next place, the cost of coal is a very material item, greatly dependent on the service, on which the vessels may be employed. This I have assumed at £2 per ton weight as the average cost of the yearly consumption. Next, as to the ship; I have assumed that a ship of 2,500 to 3,000 tons *load displacement* would be purchased from the builders as a ship of about the same amount of tonnage, builders' measurement, and that the cost of the ship, completely fitted, equipped and furnished in all respects ready for sea, would be £25 per ton. Then, assuming the interest on investment at £5 per cent. per annum, the upholding and replacement at 10 per cent. per annum, insurance at 5 per cent. per annum, and wages and rations of officers and crew all the year round at £3 per 100 tons per week, on these data we shall have the prime cost expenses incidental to the hull amounting to £6 11s. 2d. per ton of tonnage per annum, which is 8d. per day sea-time, assuming the vessel to be at sea 200 days per annum, exclusive of harbour dues, lights and pilotage, which are supposed to be the same for all ships of equal tonnage.

Next, as to the engine department:—

The average price of marine condensing engines, as now usually constructed, may be rated at £50 per nominal horse-power, and in general each horse-power nominal may be expected to work up to 2½ indicated horse-power, so that the cost of marine engines may be rated at £20 per indicated horse-power. Then, assuming the interest on investment at 5 per cent. per annum on the contract cost, the upholding and replacement at 10 per cent., insurance 5 per cent., wages and rations of engineers and stokers at £5 per 100 indicated horse-power per week, consumable stores (coal excepted) £2 10s. per 100 indicated horse-power per week, on these data we shall have the prime cost expenses incidental to the engine department (exclusive of coal), amounting to £7 18s. per indicated horse-power per annum, which is 9d. per day per indicated horse-power sea-time, assuming the vessel to be at sea 200 days per annum.

These assumed data of pecuniary charges incidental to steam-ship transport service, as applied to mercantile purposes, combined with the mutual relations of displacement, power and speed, which are derivable from the foregoing formula $\left(\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}} = C\right)$ according to the constructive type or locomotive quality of the ship, as shown by the co-efficient or index number, C, enable us to make up the prime cost expenses, being the minimum at which goods can be conveyed, and which, therefore, should constitute the base of the estimate by which a mininum scale of freight charges should be estimated: and applying these data to the ships A and B, employed on a passage of 3,250 nautical miles, as exemplified in the supplement to "Atherton's Steam-ship Capability," 2nd edition, page 78, the minimum scale of freight charges per ton of goods, according as the vessels may be powered for a speed of 8, 10, or 12 knots per hour will, on the data referred to, require to be as follows:—

	8 KNOTS.	10 KNOTS.	12 KNOTS.
Ship A	£1 15 7	£2 4 6	£3 4 6
Ship B	2 7 2	3 9 8	6 16 3

The proportions in which goods, according to their respective kinds, may be made to bear freight charges so as to yield the average return per ton weight on the entire cargo, is altogether a matter of commercial discretion and management. The entire cargo must be made to yield the average return per ton weight here set forth.

Hence it appears that 12 miles speed involves about double the freight cost of the 8 miles speed with the superior ship, A, and nearly three times the cost of the 8 miles speed with the ship B; and 12 miles speed with the ship, B, is about four times as expensive as the 8 miles speed with the ship, A. Also, the extra cost to the public at which freight charges are enhanced by the inferior type or inferior working condition of ship B, as compared with the ship, A, if continuously employed on the passage of 3,250 nautical miles, and under the data referred to, assuming the consumption of coal to be at the rate of 4 lbs. per indicated horse-power per hour, and according as the steaming speed of both ships may be 8, 10, or 12 knots per hour, is no less than 32 per cent. at 8 knots, 56 per cent. at 10 knots, and 111 per cent. at 12 knots. Undoubtedly, the details of the data on which the foregoing calculations have been based are open to correction, and will greatly depend on their application to special services on considerations immediately connected with such special service, and cannot be generalised; but, whatever alteration of these data may be applied to the ship, A, must likewise be applied to B, so that, although the foregoing estimate of the actual cost expenses of freight may be considerably modified by our altering the date of the calculations, still the per centages of difference above set forth, showing the *degree* or per-centage in which freight charges for the passage of 3,250 miles are enhanced in consequence of the inferiority in locomotive properties of the ship, B, as compared with the ship, A, will not be much altered from the per-centages above set forth, showing an enhanced cost of freight to be paid by the public on bringing cargo, grain, for instance, from the States, or from the Black Sea, to England, amounting to 32 per cent. at the 8 knots speed, 56 per cent. at the 10 knots speed, and 111 per cent. at the 12 knots speed, extra charges incurred on freight per ton of goods conveyed, and to be paid by the public, in consequence of the dynamic inferiority of ship B as compared with ship A. It is surely in consequence of the public not being generally aware of the high scale of prime cost charges necessarily involved in a 12 miles speed (steaming speed at sea) as compared with an 8 miles speed, that such high speed is so universally demanded by the public, and it must surely be in consequence of an almost similar want of insight into the real cost of high speed on the part of directors that obligations as to speed are so frequently incurred, at a price inadequate to such service. If the public will have a progressively increasing high rate of speed, they must pay for it about in the ratio at which they purchase iron, copper, silver, gold, and diamonds, either of which may be bought too dear for common use.

The foregoing results have been based on the supposition that the consumption of fuel in both ships is at the rate of 4 lbs. per hour per indicated horse-power. My own experience, however, induces me to be of opinion that this rate of consumption is but very seldom realised, and that 5 lbs. of coal per indicated horse-power per hour is much nearer in accordance with our present actual steaming practice. It is, therefore, important that we show to what extent the rate of transport freight expenses will be enhanced if the service above referred to—viz., 3,250 nautical miles direct—be performed with an inferior construction of boiler, causing a consumption of 5 lbs. of coal per indicated horse-power per hour, instead of 4 lbs., as above calculated on. In this case, according as the speed for which the vessel may be powered is 8, 10, or 12 knots an hour (see "Steam-ship Capability," page 78), the cost expenses incurred by vessel A, instead of being £1 15s. 7d., £2 4s. 6d., and £3 4s. 6d., per ton weight of cargo, will now amount to £1 19s. 5d., £2 11s. 4d., and £3 19s. 1d. per ton weight of cargo; this increase of prime cost freight expenses per ton of goods being 11 per cent., 15 per cent., and 22 per cent., according as the service speed may be 8, 10, or 12 knots per hour, solely in consequence of the inferiority of the boiler or inferiority of boiler management, causing this extra consumption of fuel; and further, if this greater consumption of coal be combined with the inferior type of vessel B, the prime cost expenses of freight per ton of goods, instead of being £1 15s. 7d., £2 4s. 6d., and £3 4s. 6d., will now be £2 13s. 7d., £4 5s. 5d., and £9 15s. 2d.; this increase of freight cost being 18s. per ton, £2 0s. 11d. per ton, and £6 10s. 8d. per ton weight of cargo conveyed, or 50 per cent., 100 per cent., and 202 per cent. extra charge incurred, according as the service speed may be 8, 10, or 12 knots per hour. These results show the monstrous extent, in a pecuniary point of view, to which the public are interested in the general quality of the type of ships and machinery adaptation thereto, and working condition of ships by which the mercantile transport service of the country may be prosecuted. But let us look a little further into this matter, in the hope of obtaining a more definite appreciation of the total extent in £ s. d. to which the British public are interested in having their mercantile transport service performed to the best advantage. It has been publicly stated ("Times," June 18, 1856,) that at the twelve principal ports of the United Kingdom, during the year 1855, ship tonnage to the extent of 6,372,301 tons entered inwards, and 6,426,566 tons cleared outwards, making altogether 12,798,867, say 12½ millions of tons of tonnage per annum, and since mercantile shipping will probably, *on the average*, carry dead weight of cargo to the full extent of their register tonnage, it is probable that the tons weight of merchandise constituting the cargoes of ships arriving at and sailing from the United Kingdom, amounts to no less than 12,000,000 of tons per annum; of which, for the purpose of illustration, we will suppose that 1-6th part, or 2,000,000 of tons, is conveyed by steam power on a passage of 3,250 nautical miles, under the circumstances of the data that have been assumed as the base of the foregoing calculations; and since we have shown, under these circumstances, that the prime cost expenses of freight per ton of goods may be enhanced by an inferior type of ship and machinery, or inferior management thereof, to the extent of 18s., £2 0s. 11d., and £6 10s. 8d. per ton weight of goods conveyed, it follows that the extra charges for freight on the assumed quantity of 2,000,000 of tons weight per annum, will amount to the extra annual cost or public loss of £1,800,000 at 8 knots speed, £4,916,666 at 10 knots speed, and £13,666,666 at 12 knots speed, according as the type of ship and machinery by which the work is performed may be of the inferior type B, as compared with the superior type A; seeing also, that it is the public interest which has to bear the brunt of our national goods transport service, being either as respects construction or working condition anything short of that degree of perfection which the application of science might achieve; is it not, therefore, of importance that our public system of statistical shipping registration should be complete, especially in those points which are essential for scrutinising the dynamic properties of steam-ships, thus leading to the recognition of good practice on the one hand, or the exposition of bad practice, and consequent public loss, on the other. Ships may be regarded as national implements for doing the work of the nation, and should, therefore, be subjected, by the aid of statistical registration, to public scrutiny, as conducive to their being upheld fit to do their work in the best manner. A shipbuilder will not allow his interests to be trifled with by the use of a blunt adze, so the public interest requires that its national transport service, in the conveyance of goods, should not be performed by bad ships if the statistical grindstone will obviate the evil. Nevertheless, the public statistics of British shipping afford no data available to science for promoting or even protecting from abuse the great public interests which are involved in the proper execution of its transport service, amounting probably to 12,000,000 tons of per annum. It is pre-eminently for the British Association to suggest the remedy for this humiliating fact.

The subject herein treated of admits of extended illustration beyond the limits of time that I may presume to occupy at a meeting of the British Association. I only profess to have broken up new ground in showing that mercantile transport service by steam-ships admits of being brought within the range of arithmetical calculation, whereby the dynamic quality of ships, the size of ships as measured by displacement, the working quality of engines and engine-power as measured by the unit indicated horse-power, and the speed to be assigned as the condition of any service, may each of them be treated as functions of calculation involving definite pecuniary considerations, constituting a system which may be denominated the "arithmetic of steam-ship adaptation to the requirements of mercantile service." By the application of these principles of calculation, I submit that errors in steam-ship construction, or neglect of its working condition, may be exposed, correction will follow, the directorial management of steam-shipping affairs, as respects steam-ship capability, will be based upon arithmetical calculation, thereby prosecuting its assigned service with confidence, and rejecting all Utopian projects that will not pay. Thus, science will produce its fruit in promoting public interests, without detriment to the fair competitive pursuits of any class, by producing a sound, well-understood, and healthy condition of steam-ship management, and consequently of "Mercantile Steam Transport Economy."

REMARKS BY JAMES R. NAPIER, GLASGOW, ON A PAPER READ, BY MR. ATHERTON, AT THE CHELTENHAM MEETING OF THE BRITISH ASSOCIATION.

I QUITE agree with Mr. Atherton in regard to the indefiniteness of the term Horse-power, as at present used in steam-engine contracts, and in the desirableness of having a dynamical unit or standard of power or work legalised, as well for the purpose of buying and selling machines producing power, as for that of scientific comparison. The rule or formula established by James Watt, for the horse-power of condensing engines was $\frac{A \times P \times V}{33{,}000}$ or $\frac{\text{foot, lbs., per minute}}{33{,}000}$ = horse-power, where the pressure (P), and velocity (V), had either their *actual* values or fractional parts thereof. But at the present time, the pressure (P) is continued at what it was in the days of Watt, viz., 7 lbs., no matter what the actual pressure may be now. And for the velocity (V) almost every engineer has a scale of his own, varying according to the length of stroke of the steam piston; some assuming the velocities to vary as $\sqrt[2]{}$ (of the length of stroke), others following the Admiralty rule for paddle-engines, assuming the velocities to vary as $\sqrt[3]{}$ (of the length of stroke.) All these assumptions, moreover, have no necessary connection with the results desired, nor with the actual results afterwards obtained, nor do they answer any better the purpose, either of the buyer or seller; and all the use they subserve is to fix the size of the cylinder by the very round-about method of resolving an arithmetical or algebraical equation, in which two of the three quantities—diameter, length of stroke or velocity, and horse-power are required to be known.

As the standard Horse-power applied to steam-engines was fixed by Watt at 33,000 lbs. raised 1 ft. high per minute, and as this same value is used by the Americans, the French, the Germans, and, I presume, by all nations where the history of the steam-engine is known, I would be very sorry to recommend any change as to the use of the name in any other sense than as synonymous with 33,000 ft. lbs. per minute. I see no objection, however, to the entire abolition of the term *nominal* horse-power, as it is of no use whatever to the engineer, as little to steam-engine owners, and deceitful to the public.

As I adhere to 33,000 ft. lbs. per minute being received as a horse-power, I would object to the 33,000 being altered into 132,000, or into any other figure, without at the same time changing the name to something altogether different from horse-power, or marine horse-power. I would suggest that the standard unit of power be expressed in foot lbs. alone, as this is a term already known to all scientific nations. Dividing by 1,000,000, the result would be stated in millions of foot lbs. Thus the *Banshee*, which is, according to Mr. Atherton's work on steam-ship capability, 350 nominal horse-power, shows by the indicator a power of 57,816,000 foot lbs., or $57\frac{8}{10}$ million foot lbs.

As to the tonnage question, I feel I know very little about it, except that the present law is very complex, and certainly does not give what Mr. Atherton would like, viz., the displacement.

That part of Mr. Atherton's paper concerning the comparison of vessels is very important. What other writers have called the efficiency, or the ratio of the power expended to the work produced, is surely a subject which all ship-owners ought to be acquainted with. The formula adopted by Mr. Atherton for the efficiency or dynamical duty of steam-ships is, however, I fear, too rough an approximation to be recommended for general adoption, especially when a more exact and equally simple formula is at hand, and the one also from which Mr. Atherton's adopted formula is no doubt deduced, viz. $\frac{V^3 \times \text{midship section}}{\text{Indicated H.P.}} = C$. The power in similar vessels, I here take for granted, varies as the cube of the velocity, and also directly as the immersed midship section. For similar vessels the midship section no doubt varies as displacement raised to the power, $\frac{2}{3}$; but scarcely any two vessels are *similar* (in the mathematical sense of the term), nor is the same vessel similar to itself when the draught of water varies.

The following table, deduced from published statements of some of the ships of the Navy, and also from vessels built by the firm with which I am connected, shows the difficulty there would be in the use of the formula V^3 (displacement) $\frac{2}{3} = C$, arising from the (displacement) $\frac{2}{3}$ having no necessary connection with the midship section:—

COMPARISON BETWEEN MIDSHIP SECTIONS, AND ($\frac{2}{3}$ DISPLACEMENT.)

	Area of Mid. Section.	(Displ.) $\frac{2}{3}$.	Ratio of Mid Sec. to (Dis.) $\frac{2}{3}$.
Ajax	807	212.5	1000 : 263
Amphion	546	160·	1000 : 290
Arrogant	580	181·4	1000 : 313
Blenheim	738	198·2	1000 : 267
Dauntless	522	171·2	1000 : 328
Euphrates	570	179·25	1000 : 314
Hogue	820	215·	1000 : 261
Horatio	537	142·8	1000 : 266
Sans Pareil	920	229·8	1000 : 250
Simoom	567	198·18	1000 : 350
Termagant	587	179·4	1000 : 306
Black Swan	385	140·76	1000 : 366
London	233	86·89	1000 : 373
Lady Eglinton	207	77.33	1000 : 373
Queen	122	44·5	1000 : 365
Bogota (P) very deep	330	134·51	1000 : 408
Victoria (P)	47	25·	1000 : 532
Vulcan (P)	56	26·962	1000 : 481
Lancefield	244	draft. 96·8	1000 : 397
Fiery Cross	270	12·11½ 100·2	1000 : 371
	331	14·11½ 117·5	1000 : 355
	394	16·11½ 135·08	1000 : 343

In the *Fiery Cross*, at different draughts of water, there is a difference of nearly 3 per cent. in the ratio of midship section to (displacement) $\frac{2}{3}$, which might affect the co-efficient C to the same extent.

The *Victoria* and *Vulcan* are two river steamers of nearly the same size and power, yet there is upwards of 5 per cent. of difference in the ratio of midship section to (displacement) $\frac{2}{3}$. The formula used by Mr. Atherton is, notwithstanding these remarks, exceedingly useful for commencing the designs of steam-vessels, and may be an approximation sufficiently near for most practical purposes.

In reference to the table of the performances of steamers, which I recently gave to Mr. Atherton, it is necessary to remark that too much confidence is not to be placed in it as an exact document. Though I aimed at the truth, it is possible I may have erred in the speed which is generally on the Clyde tried between the Clock and Cumbrae lighthouses, or $13\frac{2}{3}$ nautical miles—too great a distance for maintaining a uniform speed, especially in new vessels, with strange firemen, &c. I believe the statement, however, to be nearly true, and the study of it affords useful lessons. The last column shows the efficiency of the vessels by both formulas; I adhere, however, to the mid-section formula, as being the more correct.

The *Vulcan's* speed and power is deduced from a number of trials at a measured statute mile on the Gareloch. The *Simoom's* performances I obtained from one of the dockyards.

The *Bogota*, a common paddle-wheel steamer employed by the Pacific Steam Navigation Company, and loaded very deeply at her trial, shows a very inferior result to that of the screw steamer *Black Swan* (now *Ganges*), not deeply laden. Their displacements are nearly alike, and their speeds about equal; yet the paddle-vessel, too deeply laden, requires about 60 per cent. more power than the screw.

The *London* and *Lady Eglinton* are two screw-vessels near enough alike to be comparable. Their screws are the same diameter, but the one is more immersed than the other, which, I imagine, is sufficient to account for at least part of the difference in the efficiency of the two vessels.

The *Edina* was constructed by Messrs. Barclay and Curle, and her engines by Inglis; I was kindly invited to the trial, and got the particulars of displacement, power, and mid-section from the constructors. The trials of the screw-steamer *Lancefield* are not so satisfactory as could be desired, there being a little uncertainty as to speed. At the first trial the screw was only partly immersed; the result shows a very low coefficient. The speed at the other trials is uncertain, as it was taken at sea, and not in the usual way for such calculations.

I was unfortunate in not getting the particulars of the power and speed of the *Persia* before she left the Clyde, so as to add her performances to the table.

Mr. Atherton, in a letter to the President of Section G, on Mechanical Science, says:—

SIR,—With reference to Mr. James R. Napier's remarks on my paper, "Mercantile Steam Transport Economy," I beg to submit the following observations:—Mr. J. R. Napier concurs with me as to the indefiniteness of the term "nominal horse-power" as at present applied in marine engineering practice, and in the desirableness of having the unit of power, denoted horse-power, specifically defined; and he prefers that the measure originally proposed and acted upon by Watt—viz., 33,000 lbs. weight raised 1 ft. high per minute—be now adopted as the statute unit of horse-power.

On this point I have merely to remark that, scientifically, it is a matter of indifference what may be the statute measure of the unit, provided it be specific. In my essay on "Steam-ship Capability," I based my calculations and tables on 132,000 lbs. raised 1 ft. high per minute, because that was the average performance, per nominal horse-power, of the ten mail packets then employed in Her Majesty's service. In my paper on "Mercantile Steam Transport Economy," I have suggested that 100,000 lbs., raised 1 ft. high per minute be adopted as the statute unit of horse-power, because that is, I believe, about the average present practice in the highest class of our merchant steam shipping, and this measure of the unit would facilitate calculations; but whether 33,000, or 100,000, or 132,000, or any other number of lbs. weight, raised 1 ft. high per minute, be adopted as the statute unit of horse-power is a mere matter of convenience, a question very proper for being submitted for the consideration and recommendation of a committee.

As to the question whether the formula $\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}}$ or $\frac{V^3 \text{x. Mid. Sec.}}{\text{Ind. H.P.}}$ would be the better formula for determining the relative dynamic merits of steam-ships, these formulæ are, as respects similar types of *immersed* form, a mere transformation of terms, for, in similar types of form, the immersed midship section will vary in the same proportion as the cube root of the square of the displacement. These formulæ would, therefore, give proportional results. I have, however, preferred the formula based on displacement $\left(\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}}\right)$ because this formula may, as I believe, be made the base of calculations as to the capability of ships for mercantile service, for which purpose the formula based on midship section, without reference to displacement, is inadequate.

The table of data now supplied by Mr. J. R. Napier is a valuable addition to our statistical data, in so far that, after having determined the relative dynamic merits of the ships referred to, and classified them accordingly, the information afforded by this table will aid in the analysis of their respective types of form. I would, however, beg to suggest that the position of the centre of gravity of the immersed midship section of each ship, expressed by its depth below the surface line, at which the displacement has been calculated, would be a very important addition to this table, and it is hoped that Mr. James R. Napier will be able to supply it.

In fact, it is in consequence of the depth of the centre of gravity not being noticed in the formula above referred to that I have spoken of it in my paper as "open to criticism" and probable amendment, and I shall be prepared, in committee, to submit this view of the case for consideration, requesting that this letter be read conjointly with Mr. Napier's remarks, &c., &c.,

CHAS. ATHERTON.

THE FOLLOWING REPORT WAS READ IN SECTION G.,
ON FRIDAY, AUGUST 8.

Provisional Report to the British Association for the Advancement of Science, on the progress of a Committee appointed at the Meeting in Glasgow, September, 1855, to consider the question of the Measurement of Ships for Tonnage, consisting of the following gentlemen:

Mr. ANDREW HENDERSON,	Mr. ALLAN GILMORE,
Mr. J. R. NAPIER,	Mr. CHAS. ATHERTON, and
Mr. JOHN WOOD,	Mr. JAMES PEAKE.

As the first-named member of the committee on tonnage measurement, it becomes my duty to report progress in the matters referred to us, and in so doing, I beg to premise my report with the remark, that I was induced to propose this committee from having had the honour of reading a paper on Ocean Steamers, Clipper Ships, and their descriptive measurement, to the Association, at their meeting at Liverpool (*vide* p. 152 to p. 156 of Report, 1854). While at Glasgow, in 1855, a new shipping bill having come into operation, I found the extreme interest, then publicly taken in the general question of Government interference in shipping affairs, seemed to render this Committee expedient.

The serious and important character of the subject thereby involved, and the consequent responsibility imposed on all individuals who may take a prominent part in this matter, have operated as an obstacle to the immediate establishment and working operation of this committee. In the first place, I beg to notice that the subject of tonnage registration, as connected with our national statistics of shipping, had been brought to the notice of the public, both at the Institution of Civil Engineers, by myself, in 1853, and at the Society of Arts, by Mr. Charles Atherton, in a manner which has fully set forth the importance of the subject, and shown that legislative enactment will be necessary, in order to correct the deficiencies of our present tonnage registration of shipping; the subject having been thus brought before the public in its most serious and important aspect, has apparently induced several of the gentlemen proposed for this Committee to decline the task thus expected of them.

The absence from Glasgow of many interested in the subject rendering previous communication impracticable, the president and officers of the mechanical section, deeming it desirable that the three scientific bodies before whom the subject had been brought, should participate in the investigation, Mr. John Scott Russell was nominated to represent the British Association, and it being also considered expedient to follow the precedent of the tonnage committee of 1849, comprising shipowners, shipbuilders, officers of the Royal Navy, merchant service, and Trinity House, gentlemen connected with "Lloyd's Register," and their surveyors, with several naval architects, and engineers; there were proposed—Mr. Allan Gilmore, Mr. John Wood, and Mr. James R. Napier, representing the shipowners and builders of Scotland; Mr. C. Atherton and Mr. J. Peake the latter professions, with the understanding that they were to seek the co-operation of others.

Accordingly, application was made to noblemen, officers and engineers connected with the navy, the Society of Arts, and Institution of Civil Engineers, the shipowners' societies of London and Liverpool, the committee of Lloyd's register of shipping, and to shipbuilders. Although many of these gentlemen of scientific attainments and practical experience offered to participate in the investigation, difficulty and delay occurred from some of the members of the committee being resident in distant parts of the country, while for the deposit of papers and plans for references by the committee, no provision had been made even in the metropolis, the only means of bringing them under consideration was the forwarding copies of them to the principal ports that the members might elicit the opinion of the local marine boards and shipowners.

With this view application was made to the Board of Trade for copies of Acts and Parliamentary papers bearing on the question, to be submitted to the members of the committee of the British Association in their investigation of tonnage measurement.

The official reply was that the Board of Trade "do not consider that the law of tonnage measurement requires alteration, or that the subject requires further investigation with any view of amending the law." "Most of the papers to which you refer are published, and can be purchased. Those which have not been published and which are among the records of this office, my Lords cannot part with, but you are at liberty to inspect and take copies of the plans which you have yourself submitted to the board."

In addition to these delays and the difficulties thrown in the way by the routine of a public office, Mr. Allan Gilmore and Mr. John Wood, of Glasgow, expressed a desire to withdraw from the committee, and Mr. Scott Russell's engagements, especially in connection with the construction of the great ship for the Eastern Steam Navigation Company, have so engrossed his time and attention as to have put it out of his power to take that interest in this question which has hitherto so laudably characterised his exertions in the cause of science, in connection with the labours of the British Association.

Mr. Atherton also declined, on the ground that the public agitation of the question referred to, in which, during the past year, he was engaged before the Society of Arts, disqualified him for the time being from taking part on this committee; consequently, Mr. James R. Napier and Mr. James Peake were the only parties available for co-operation with myself (Mr. Henderson) in this matter, and it has therefore been considered most advisable, under the circumstances above referred to, not to officiate in our collective capacity as a committee of the British Association, but simply to give our individual aid in promoting the discussions which have thus sprung up.

With this view, I have myself taken a personal interest in the discussion of the tonnage registration question before the Society of Arts, as exemplified by the documents submitted herewith, showing a large amount of statistical data on steam-ship performances, which has been collected by me since I originally brought it before the Institute of Civil Engineers, in 1847, with the view of collecting, in the archives of that institution, statistics of the progress of improvement in our mercantile marine.

The papers comprise my view as to tonnage measurement, as laid before the Board of Trade in 1850 and in 1852, and as to steam navigation and the speed realised by mail steamers, as laid before Parliament in 1851, papers read before our Institution of Civil Engineers in 1853, the British Association in 1854, and published by the Society of Arts in 1855; together with the discussions that have taken place in the Journal of that Society, in 1856, on Mr. Atherton's paper on Tonnage Registration. The system of measurement I proposed to the Board of Trade in 1850, being exemplified by a *pro forma* certificate of survey, appended to the paper, as well as by a tabular analysis of the proportion and displacement of different ships and modes of measurement. Including the paper read before the Association last year, and subsequent information, as well as proposed new rules, will be printed complete, before submitting them to the consideration of any committee or authority that will investigate the whole question.

Mr. James R. Napier has, I understand, during the past twelve months, collected much statistical information on the trial performances of steam ships, and Mr. Peake has taken the opportunity of drawing public attention to the question of the mode of measurement most available for shipping operations. By these means I beg to bring to the notice of the general committee, that the individual labours of Mr. Atherton, Mr. Napier, Mr. Peake, and myself, have now contributed materially to the elucidation of the subject referred to, thereby facilitating any further effort that may be decided on, and the favourable manner in which Mr. Atherton's paper on the analagous subject of "Mercantile Steam Transport Economy" has been received at the mechanical section of the Association, affords every prospect of the labours of this committee being now prosecuted under far more encouraging prospects of public support and co-operation, on the part of the shipping interests themselves, than has hitherto been the case.

As an example of the benefit to be derived from public discussion, I may refer to the "Mechanics' Magazine," published during the months of April, May, and June last, in which, after fully investigating the subject of the deficiencies of our present tonnage registration for scientific purposes, the editor has been pleased to announce the following admitted deficiencies and proposed corrections of our present system for the consideration of its numerous readers:—

"1st. That the tonnage, measurement, and registration of vessels has never been brought before Government in any other than a purely fiscal point of view."

"2nd. That Government, in legislating on tonnage registration, has not contemplated the scientific features of the case, nor those which bear on the sea voyage."

"3rd. That undoubtedly there is a point beyond which ships cannot be safely loaded."

"4th. That undoubtedly it would be desirable, if possible, to fix a limit to the degree to which ships may be loaded."

"5th. That as respects the draught of water at which ships leave port, let the Board of Trade have, if it so pleases, properly authorised officers to note and record the facts.

"6th. We would see with satisfaction a competent committee appointed by Government or by the British Association, with a view of ultimately, if need be, acting on the government, to take into consideration the foregoing points."

Such being the declaration of opinions expressed in respect to the deficiencies of our present system of statistical registration of tonnage, it is respectfully submitted that good and sufficient cause is shown for the re-appointment and further continued labours of the committee on this subject, and that under such indications of the public appreciation of the utility of such labours, there can be no doubt of such amendments of the present system being obtained as will conduce to public good.

It may be in the recollection of members that at the Meeting of the British Association at Liverpool, in 1854, the recommendations of the general committee included one:—"That it was expedient for the advancement of naval architecture, that a portion of the intended Museum at Liverpool should be appropriated to this subject." Little progress having been yet made with the museum at that port, while the want of such an establishment for the record and disposal of papers and models, added to the difficulties of the committee of 1855; it is with satisfaction I have to state that such difficulties may be considered removed for the future, by the considerate offer of the Chairman of the Crystal Palace Company, Mr. Arthur Anderson, to lend the Naval Gallery of the Palace in any manner that can aid the objects of the committee, or ventilate the subject.

Considering that there are already collected at the Crystal Palace naval gallery models of ships and steamers, fishing-boats, and life-boats, both English and foreign, ancient and modern, a comparison can be there made of the rapid improvement in shipping and steam vessels since the old tonnage law was abandoned, the great desideratum being that on the six points enumerated, the question shall be better understood, and facilities afforded for investigation and the re-examination of our system of measurement and registration. The vast advantages that would thereby accrue to our mercantile marine, it is to be hoped will induce every effort to be made by the British Association.

The following resolution was passed at a general meeting of the British Association, 13th August, 1856:—

"That the committee consisting of Mr. Andrew Henderson, Mr. John Scott Russell, Mr. James R. Napier, and Mr. Charles Atherton, appointed to consider the question of the measurement of ships for tonnage be requested to continue their investigations; that the following members be added to the committee, the Right Hon. the Earl of Hardwicke, Arthur Anderson, Esq., the Rev. Dr. Woolley, William Mann, Esq., G. F. Young, Esq., Capt. T. P. Owen, Professor Woodcroft, and Mr. James Perry; and that they be requested to inquire into the defects of the present method, and to frame more perfect rules for the measurement and registration of ships, and also as to the adoption of a standard unit for estimating the working power of engines instead of the present nominal horse-power, in order that a correct and uniform principle of estimating the actual carrying capacity and working power of steam-ships may be adopted in their future registration."

ON THE QUANTITY OF HEAT DEVELOPED BY WATER WHEN VIOLENTLY AGITATED.

By George Rennie, Esq., F.R.S.

This interesting paper was read before section G, on Saturday, August 9th. Mr. Rennie said:—

Our knowledge of the mechanical properties of heat has been greatly advanced since the year 1798, when Count Rumford published his valuable paper on the source of heat excited by friction. The investigation of Dr. Black, and subsequently of Watt, Southern, Creighton and Murdock, of the Soho school, and of Lavoisier, Mongolfier, Dulong, Seguin and Mayer have been engaged in similar researches; while the chemical, or rather mechanical properties of heat, have been largely augmented by the researches of Kirwan, Dalton, Leslie, Taylor, Davy, Faraday, Andrews, Graham, Hess and Thompson.

1st. The effects of electric action in decomposing or separating compound bodies.

2nd. The effect of compression and extension of solids in developing heat.

3rd. The effects of the chemical affinity of acids, and metallic or saline bases.

4th. The effects of spontaneous combustion of metals and gases, and of oils and fibrous substances.

5th, and finally, of the condensation and expansion of fluids and gases, have all been the objects of minute attention by modern philosophers, and those who have contributed so largely to this department of knowledge, such as Andrews, Graham, Joule and Rankine; and the magnificent experiments of Monsieur Regnault, undertaken under the auspices of the French Government for the purpose of determining numerically the laws which enter into the calculations of steam-engines, have thrown a new light upon the subject. These new values are detailed in the report of M. Regnault, published in the year 1847, and that able philosopher gives us reason to expect ere long the results of his further researches. But it is to the valuable experiments of M. Joule, communicated to the British Association in the years 1847 and 1848, and afterwards to the Royal Society in 1849, that we became first acquainted with the numerical value of heat as a mechanical power. These experiments were made on three dissimilar fluids: water, mercury and oil—and in all three cases the remarkable result appeared that the mechanical power represented by the force necessary to raise 782 lbs. 1 ft. high, produced the quantity of heat equal to raise the temperature of 1 lb. of water 1° of Fahrenheit. This equivalent was afterwards altered by an improvement in the apparatus with which he experimented, to 711 lbs., thus confirming the experiments of Rumford and Davy on the friction of solids, and proving that the heat of elastic fluids consists simply in the *vis viva* of their particles.

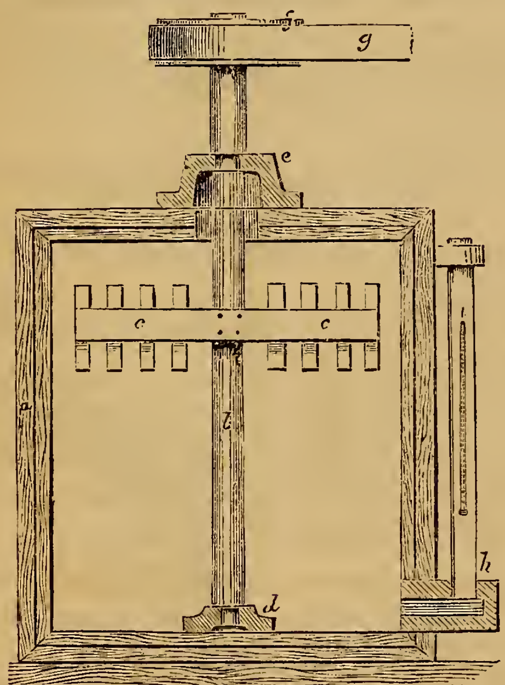
When in 1845 and 1847 M. Joule employed a paddle-wheel to produce fluid friction, he obtained equivalents of 781·5, 782·1 and 787·6 respectively, from the agitation of water, sperm oil, and mercury. These and other experiments left no doubt on his mind as to the existence of an equivalent relation between force and heat. The care bestowed upon these experiments, in deducting the retarding influences, entitle them to every credit.

Upon examining M. Joule's tables, it does not appear that the temperature of the water had been raised more than 0·5630 to 2·9, say half a degree to 97470·2 grains, or as 1° to 784·702 lbs. of water, or to a higher temperature in mercury, or than 31·31 by mercury. It is desirable, therefore, that these experiments should be extended.

Having long entertained the idea that steam, as applied to the movement of engines, lost a large portion of its heat by transmission, I watched carefully the different attempts which have hitherto been made by inventors for the direct application of heat, or caloric transmitted through air for producing motion;

Of Neipce, in France, in	1806
Of Sir George Cayley, in	1807 and 1838
Of Stirling, in	1816
Of Ericson, in	1826 and 1830

and the beautiful contrivances of the combined steam and ether-engine of Du Trembley gave reason to expect that the loss of heat occasioned by the use of steam, and which has been variously estimated at from $\frac{1}{13}\frac{1}{15}$ of the heat transmitted, led to the expectation that we should ultimately discover a more suitable medium than steam. All these attempts, with the exception of the ether-engine, have as yet been arrested by the rapid oxydation of the engines.



These statements have been further confirmed by the following tables of M. Siemans:—

	Thermometer.	Fahrenheit.
Formula of Holtzman, in foot pounds	1,227	682
Experiments of Joule	1,386	770
Formula of Rankine	1,252	695
For the best Cornish engine, Rumbaur	148	82
For high pressure condensing low pressure engine	90·8	50·4
For a good Boulton and Watts engine.	46	25·5

In March last, being at Southampton, it occurred to me to make an experiment on the difference of temperature, which might occur between the temperature of the water in the floating basin, and the water then running through the sluices of the iron gates of one of the dry docks, for the purpose of letting a vessel out from the dry dock into the basin. The result was a difference of 2 degrees between the temperature of the water in the basin and dry dock.

Frequent observations on the increased warmth of the sea in stormy weather, and in water running through mill races, coupled with the observations made at Southampton, induced me to make the following experiments.

For this purpose, a box or cistern, made of deal, 22¼ sq. in., and 30 in. deep, was prepared; a quantity of Thames water, about 22 in. in depth, was poured into it, equal to 437½ lbs. Into the side of the box was fitted a bent iron tube of 2 in. in diameter, and into the upper part of the bend of the pipe a glass tube was inserted, so that by suspending a glass thermometer in the water contained in the tube the temperature could be easily seen.

The box was then covered by a wooden lid so closely fitted as to exclude the surrounding air, and to prevent the loss of water by agitation. A wooden spindle, having four arms and twelve vertical agitators, was previously fitted into the lid of the box, as shown by the accompanying drawing, a pulley of wood was fitted to the top of the spindle, and the apparatus was rapidly revolved in the water by being connected with a steam engine.

The following illustrations exhibit views of the apparatus, and the accompanying description will make the whole understood.

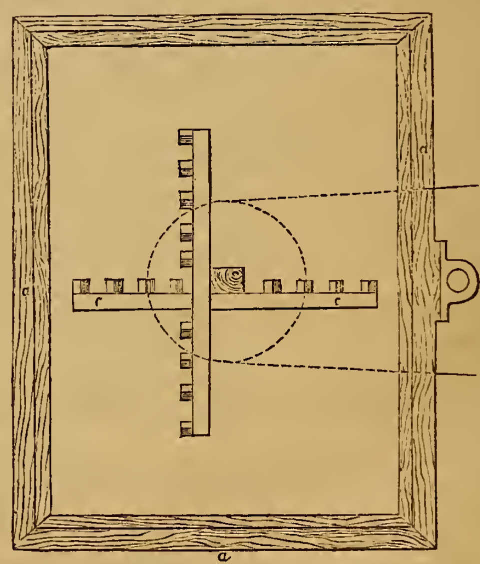
The experiment commenced on the 19th of June last.

The apparatus was then worked for an hour and a half, and the result was the raising of the temperature of the water by agitation from 58° to 64°.

The apparatus, however, got deranged, and the experiments were postponed to the following day. The Thames water was then replaced by clear well water. The apparatus was again adjusted. The quantity of water was 437 lbs. The temperature of the air was 65° Fahrenheit, when the experiment commenced, and of the water 64° Fahrenheit.

The apparatus made 270 revolutions per minute, and in 55 minutes raised the temperature of the water from 64° to 73¼°, or an increase of 9¼° Fahrenheit.

The experiments were continued on the third day with well water at 59°, and the temperature of the air 60½°. The apparatus was worked from 10·5 a.m. to 1·5 p.m., when the temperature of the water was raised from 59° to 75¼°, or 16¼° increase in three hours.



The apparatus was defective from the slipping of the strap, and only made 140 revolutions instead of 270 revolutions per minute.

The apparatus having been repaired, was again set to work on the 24th of June, being the fourth and last day of experimenting.

The following were the results:—

Number of revolutions of apparatus, 240 per minute.

Temperature of well water in the box, 59½° Fahr.

Began at A.M.	Temperature of Water.
10·0	59½ deg. Fahr.
15·5	69½ "
11·0	74 "
11·30	74 "
11·34	75 "
12·0	79 "
12·8	80 "
1 p.m	89 "

Stopped for dinner, one hour, and on starting again at 2 p.m. found that the temperature of the water had fallen to 76°, being a loss of 13°.

This, however, was owing to the tube which contained the thermometer being exposed to the influence of the east wind.

Started the engine and apparatus at 2 p.m.

At P.M.		Temperature.
2·0		76 degrees.
2·5	(increase, 10°)	86 ,,
2·15		88 ,,
3·0		92 ,,
3·30		95 ,,
4·0		97½ ,,
4·15		99 ,,
4·45		100 ,,
5·0		101½ ,,
5·15		102 ,,
5·30 stopped		103 ,,

The total increase of temperature having been 44½°, and the time 5½ hours.

On examining the foregoing tables it will be seen that the increases of temperature seem to follow no regular laws, thus :—

From 10 a.m. to 11 a.m.	the increase is	14½° Fahr.	
,, 11 a.m. to 12 a.m.	,,	5°	
,, 12 a.m. to 1 p.m.	,,	10°	
,, 2 p.m. to 3 p.m. the temperature of the water rose from 76° to 92°, being	an increase of	16°.	
,, 3 p.m. to 4 p.m. ,, 92° to 97½°,	,,	5½°	only per hour.
,, 4 p.m. to 5 p.m. ,, 97½° to 101½°	,,	4°	
,, 5 p.m. to 5½ p.m. ,, 101½° to 103°	,,	2°	

So that, had the experiments continued longer, the rate of increase per hour might have been reduced to an equilibrium.

As a proof that the box radiated very little heat, on one occasion the apparatus, after the temperature of the water had been raised from 60° to 103° Fahr., was left all night for fourteen hours exposed to the external air. The temperature of the water on the box next morning was found to be 87° Fahr., being a loss of 16°, or little more than 1° per hour.

ACCOUNT OF EXPERIMENTS MADE IN THE YEAR 1856 ON THE RESISTANCE EXPERIENCED BY SCREW PROPELLERS WHEN DRIVEN AT HIGH VELOCITIES, AND IMMERSED IN THE RIVER THAMES, AT DIFFERENT DEPTHS.

By George Rennie, Esq., F.R.S.

Read at the Meeting of the British Association, at Cheltenham, on the 8th August, 1856.

It is now nearly a year since, that the author was invited, by Mr. John Apsey, a mechanical engineer, to witness some experiments which he proposed making on his premises Broadwall (Christ Church), on the power of a double-threaded screw propeller, which he stated to have been invented and patented by him, but which had been previously invented and tried by another person.

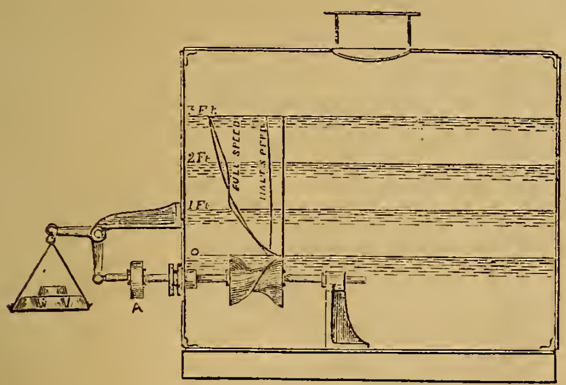


Fig. 1.

The screw, which was fastened on a spindle, as shown in the accompanying drawing, was mounted in an old waggon boiler, 6 ft. in length by 4 ft. in width, and 4 ft. in depth, one end having a pulley fixed to it, and the other supported on a bracket or stand fixed to the bottom of the boiler. The spindle was allowed to work easily through bush in the bracket, and also through a stuffing-box let into one end of the boiler, so that when the screw was made to revolve, by driving the pulley, it pressed against the water, and then against the arm of a bent lever, which raised a scale with weights, accordingly. First, the water was poured into the boiler up to the top part of the screw, and afterwards, at the different levels of *one, two, and three feet* successively.

The screw was driven by a steam engine, at 920 revolutions per minute.

The accompanying illustration (Fig. 1) will render this explanation of the apparatus perfectly intelligible.

The following were the particulars :—

Diameter of screw	13⅝ in.
Pitch of ditto	7 in.
Length of ditto	15 in.
End area of ditto	140 sq. in.

	920 revolutions of screw, the weight lifted. lbs.	At one-half, or 460 revolutions, speed of screw. lbs.
When the water was level with the top of the screw	67	63
When 1 ft. above screw	299	88
When 2 ft. ,,	350	112
When 3 ft. ,,	448	126

So that at 1 ft. above the level of the screw the increase of pressure was......... 4·46 times.
at 2 ft. above screw was .... 5·22 ,,
at 3 ft. ,, ... 6·86 ,,

While at 460 revolutions, or one-half the speed, the difference was only double, between the screw worked with the water on a level with the circumference of the screw, and when the water was 3 ft. above it.

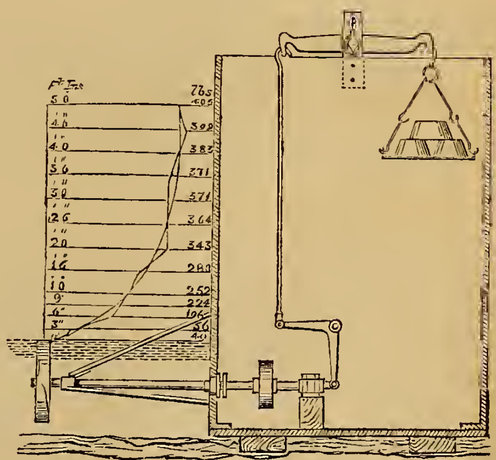


Fig. 2.

Thus showing the great effect of working the screw at high velocities.

These results, when shown by the author to the Mechanical Section at Glasgow, in September, 1855, were questioned as to their accuracy, on the ground that, being made in a boiler, the water was necessarily confined within the narrow limits of the boiler, and the pressures indicated by the screw uncertain. To obviate these objections, a new apparatus similar to that as indicated by the drawing No. 2, was constructed in the month of March last, and fixed in the river Thames, opposite to a wharf in Holland Street, Blackfriars.

The screw-propeller, having two blades similar to the common screw used in Government vessels, was fixed on the end of a horizontal spindle, and then driven by a strap connected with a steam-engine at the rate of 558 revolutions per minute, and advantage being taken of the rise and fall of the tides outside the cistern. The screw was driven, when immersed, at different depths, and the following were the results of the different experiments:—

	Weight lifted.
When the water was level with the top of the screw	49 lbs.
" " 1 ft. " "	252 "
" " 2 ft. " "	343 "
" " 3 ft. " "	369 "
" " 4 ft. " "	—
" " 5 ft. " "	405 "
Here the differences between the first and second numbers are as	1·5
Do. between first and third	1·7
Do. between first and fourth	1·7·5
Do. between first and fifth	1·8·3

While the numbers are represented by a parabolic curve nearly, thus proving the effects of high speed, when the screw is unfettered by working in a boiler. The conclusions are, that speed is more favourable to developing the power of the screw-propeller than depth, and this is more particularly shown by the slight differences of numbers when the screw was working at half-speed in the boiler, as indicated also by the curve. If these experiments be borne out on a larger scale, the inference will be that small light propellers attached to the hollow, or after-run of the sterns of vessels, and worked at high velocities, will be preferable in many respects to large and heavy propellers worked at slow velocities in the dead wood.

ON THE MANUFACTURE OF MALLEABLE IRON AND STEEL WITHOUT FUEL.

By H. Bessemer.

The President, Mr. Rennie, in introducing the Paper and its author to the members of Section G, briefly adverted to the vast importance of the process to be described, giving an outline description of the modes pursued by the old and the new process, and concluded by stating that he had seen the process performed on a large mass of iron producing an ingot very much better than it was possible to work in any puddling furnace, and of a quality purer and more uniform than any iron he had ever seen. He then introduced Mr. Bessemer, who read the following paper :—

The manufacture of iron in this country has attained such an important position that any improvements in this branch of our national industry cannot fail to be a source of general interest, and will, I trust, be a sufficient excuse for the present brief and very imperfect paper.

I may mention that for the last two years my attention has been exclusively directed to the manufacture of malleable iron and steel, in which, however, I had made but little progress until within the last eight or nine months; the constant pulling down and rebuilding of furnaces, and the toil of daily experiments with large charges of iron, had already began to exhaust my stock of patience, but the numerous observations I had made during this very unpromising period all tended to confirm an entirely new view of the subject which at that time forced itself upon my attention; viz., that I could produce a much more intense heat, without any furnace or fuel, than could be obtained by either of the modifications I had used; and, consequently, that I should not only avoid the injurious action of mineral fuel on the iron under operation, but that I should at the same time avoid also the expense of the fuel.

Some preliminary trials were made on from 10 lbs. to 20 lbs. of iron, and although the process was fraught with considerable difficulty, it exhibited such unmistakeable signs of success as to induce me at once to put up an apparatus capable of converting about 7 cwt. of crude pig-iron into malleable iron in 30 min. With such masses of metal to operate on, the difficulties which beset the small laboratory experiments of 10 lbs. entirely disappeared.

On this new field of inquiry I set out with the assumption that crude iron contains about 5 per cent. of carbon; that carbon cannot exist at a white heat, in the presence of oxygen, without uniting therewith and producing combustion.

That such combustion would proceed with a rapidity dependent on the amount of surface of carbon exposed.

And, lastly, that the temperature which the metal would acquire would be also dependent on the rapidity with which the oxygen and carbon were made to combine; and, consequently, that it was only necessary to bring the oxygen and carbon together, in such a manner that a vast surface should be exposed to their mutual action, in order to produce a temperature hitherto unattainable in our largest furnaces.

With a view of testing practically this theory, I constructed a cylindrical vessel of 3 ft. in diameter and 5 ft. in height, somewhat like an ordinary cupola furnace; the interior is lined with fire-bricks, and at about 2 in. from the bottom of it I inserted five tuyere pipes, the nozzles of which are formed of well-burned fireclay, the orifice of each tuyere being about 3-8th of an inch in diameter; they are so put into the brick lining (from the outer side) as to admit of their removal and renewal in a few minutes when they are worn out. At one side of the vessel, about half way up from the bottom, there is a hole made for running in the crude metal, and on the opposite side there is a tap-hole, stopped with loam, by means of which the iron is run out at the end of the process. In practice, this converting vessel may be made of any convenient size, but I prefer that it should not hold less than 1 or more than 5 tons of fluid iron at each charge; the vessel should be placed so near to the discharge hole of the blast furnace as to allow the iron to flow along a gutter into it. A small blast cylinder is required capable of compressing air to about 8 lbs. or 10 lbs. to the sq. in. A communication having been made between it and the tuyeres before named, the converting vessel will be in a condition to commence work; it will, however, on the occasion of its first being used, after re-lining with fire-bricks, be necessary to make a fire in the interior with a few baskets of coke, so as to dry the brickwork and heat up the vessel for the first operation, after which the fire is to be all carefully raked out at the tapping-hole, which is again to be made good with loam; the vessel will then be in readiness to commence work, and may be so continued, without any use of fuel, until the brick lining, in the course of time, becomes worn away, and a new lining is required. I have before mentioned that the tuyeres are situated nearly close to the bottom of the vessel, the fluid metal will therefore rise some 18 in. or 2 ft. above them; it is therefore necessary, in order to prevent the metal from entering the tuyere holes, to turn on the blast before allowing the fluid crude iron to run into the vessel from the blast furnace. This having been done, and the metal run in, a rapid boiling up of the metal will be heard going on within the vessel, the metal being tossed violently about and dashed from side to side, shaking the vessel by the force with which it moves; from the throat of the converting vessel flame will immediately issue, accompanied by a few bright sparks, such as are always seen rising from the metal while running into the pig-beds. This state of things will continue for about fifteen minutes, during which time the oxygen in the atmospheric air combines with the carbon contained in the iron, producing carbonic oxyde, or carbonic acid gas, and at the same time evolving a powerful heat. Now, as this heat is generated in the interior of, and is diffused in innumerable fiery bubbles through the whole fluid mass, the metal absorbs the greater part of it, and its temperature becomes immensely increased; and, by the expiration of the fifteen minutes before named, that part of the carbon which appears mechanically mixed and diffused throughout the crude iron has been entirely consumed; the temperature, however, is so high that the chemically-combined carbon now begins to separate from the metal, as is at once indicated, by an immense increase in the volume of flame rushing out of the throat of the vessel. The metal in the vessel now rises several inches above its natural level, and a light, frothy slag makes its appearance, and is thrown out in large foam-like masses. This violent eruption of cinder generally lasts about five or six minutes, when all further appearance of it ceases, a steady and powerful flame replacing the shower of sparks and cinder which always accompanies the boil. The rapid union of carbon and oxygen which thus takes place adds still further to the temperature of the metal, while the diminished quantity of carbon present allows a part of the oxygen to combine with the iron, which undergoes combustion, and is converted into an oxide. At the excessive temperature that the metal has now acquired the oxide, as soon as formed, undergoes fusion, and forms a powerful solvent of those earthy bases that are associated with the iron; the violent ebullition which is going on mixes most intimately the scoria and metal, every part of which is thus brought in contact with the fluid oxide, which will thus wash and cleanse the metal most thoroughly from the silica and other earthy bases which are combined with the crude iron, while the sulphur and other volatile matters, which cling so tenaciously to iron at ordinary temperatures, are driven off, the sulphur combining with the oxygen, and forming sulphuric acid gas.

The loss in weight of crude iron during its conversion into an ingot of malleable iron was found, on a mean of four experiments, to be 12½ per cent., to which will have to be added the loss of metal in the finishing rolls. This will make the entire loss probably not less than 18 per cent., instead of about 28 per cent., which is the loss on the present system. A large portion of this metal is, however, recoverable, by treating with carbonaceous gases the rich oxides thrown out of the furnace during the boil. These slags are found to contain innumerable small grains of metallic iron, which are mechanically held in suspension in the slags, and may be easily recovered.

I have before mentioned that, after the boil has taken place a steady and powerful flame succeeds, which continues without any change for about 10 or 12 minutes, when it rapidly falls off. As soon as this diminution of flame is apparent, the workman will know that the process is completed, and that the crude iron has been converted into pure malleable iron, which he will form into ingots of any suitable size and shape, by simply opening the tap-hole of the converting vessel and allowing the fluid malleable iron to flow into the iron ingot moulds placed there to receive it. The masses of iron thus formed will be perfectly free from any admixture of cinder, oxide, or other extraneous matters, and will be far more pure, and in a forwarder state of manufacture, than a pile formed of ordinary puddle-bars. And thus it will be seen that by a single process, requiring no manipulation or particular skill, and with only one workman, from 3 to 5 tons of crude iron passes into the condition of several piles of malleable iron, in from 30 to 35 minutes, with the expenditure of about a third part the blast now used in a finery furnace, with an equal charge of iron, and with the consumption of no other fuel than is contained in the crude iron.

To those who are best acquainted with the nature of fluid iron it may be a matter of surprise, that a blast of cold air forced into melted crude iron, is capable of raising its temperature to such a degree as to retain it in a perfect state of fluidity after it has lost all its carbon, and is in the condition of malleable iron, which, in the highest heat of our forges, only becomes softened into a pasty mass. But such is the excessive temperature that I am enabled to arrive at with a properly shaped converting vessel and a judicious distribution of the blast, that I am enabled, not only to retain the fluidity of the metal, but to create so much surplus heat as to remelt all the crop-ends, ingot-runners, and other scrap that is made throughout the process, and thus bring them, without labour or fuel, into ingots of a quality equal to the rest of the charge of new metal. For this purpose a small arched chamber is formed immediately over the throat of the converting vessel, somewhat like the tunnel-head of the blast furnace. This chamber has two or more openings on the sides of it, and its floor is made to slope downwards to the throat, as soon as a charge of fluid malleable iron has been drawn off from the converting vessel. The workman will take the scrap intended to be worked into the next charge, and proceed to introduce the several pieces into the small chamber, piling them up around the opening of the throat. When this is done, he will run in his charge of crude metal, and again commence the process. By the time the boil commences the bar-ends, or other scrap, will have acquired a white heat, and by the time it is over most of them will have been melted and run down into the charge: any pieces, however, that remain, may then be pushed in by the workman, and by the time the process is completed, they will all be melted and intimately combined with the rest of the charge, so that all scrap iron, whether cast or malleable, may thus be used up without any loss or expense. As an example of the power that iron has of generating heat in this process, I may mention a circumstance that occurred to me during my experiments:—I was trying how small a set of tuyeres could be used, but the size chosen proved to be too small, and after blowing into the metal for an hour and three-quarters, I could not get up heat enough with them to bring on the boil. The experiment was therefore, discontinued, during which time two-thirds of the metal solidified, and the rest was run off. A larger set of tuyere-pipes was then put in, and a fresh charge of fluid iron run into the vessel, which had the effect of entirely remelting the former charge, and when the whole was tapped out it exhibited, as usual, that intense and dazzling brightness peculiar to the electric light.

I have before mentioned that the fluid malleable iron is run into iron ingot moulds, leaving it to be inferred that ordinary ingot moulds may be used, or such as are generally employed by cast steel makers; but a little consideration will show that such moulds would entail an amount of labour that it is most desirable to avoid in the manufacture of iron; it is also most essential to remove the ingot to the rolls while still retaining a very high temperature, and thus avoid the re-heating which would otherwise be required; for this purpose, the moulds are placed on end in a vertical position, their insides being planed truly parallel; the bottom of the mould is moveable, and is attached to a small plunger, like the ram of an ordinary hydraulic press, the cylinder of which is attached to the mould; a force-pump is worked by the nearest steam-engine, and has a pipe which leads from it to the cylinder, so that when the mould is filled with metal, and the central part is still almost fluid, a cock is opened by the workman, which allows the water from the force-pump to raise the ram and force out the ingots, while still at a glowing white heat; the moulds are sunk below the surface of the ground, and a rail-track extends on each side of them, on which there is an iron truck, the underside of which is so formed as to receive the ingots as they are pushed out by the ram, which is then lowered by reversing the cock, and allowing the water to escape; the truck is then quickly rolled along the line of rails, taking with it the ingots to the rolls, the whole operation requiring only from one to two minutes, in which time the ingots will not have cooled down sufficient in the centre for rolling, so that the first bars will be produced and finished off fit for sale wholly without the use of fuel, and within a period of forty minutes from the time of tapping the crude iron from the blast furnaces. If the iron is made in very large quantities, the heat of some of the ingots will not be retained until they can be rolled into bars; a small oven, capable of retaining the heat, must, in that case, be erected near the rolls, in which the ingots may remain until the rolls are at liberty. As soon as the workman has recharged the converting vessel he will open another communication with the force-pump before mentioned, by means of which the moulds will be filled with water, and their temperature reduced, after which the water is to be run off, care being taken that the moulds are not, however, made so cold as to prevent them from drying off before the next charge of metal is ready. In this manner, the process of converting the crude into malleable iron, and the formation of it into ingots, may be carried on continuously throughout the day, at intervals of about three-quarters of an hour.

To persons conversant with the manufacture of iron, it will be at once apparent that the ingots of malleable metal which I have described, will have no hard or steelly parts, such as is found in puddled iron, requiring a great amount of rolling to blend them with the general mass, nor will such ingots require an excess of rolling to expel cinder from the interior of the mass, since none can exist in the ingot, which is pure and perfectly homogeneous throughout, and hence requires only as much rolling as is necessary for the development of fibre; it therefore follows that, instead of forming a merchant bar, or rail, by the union of a number of separate pieces welded together, it will be far more simple and less expensive to make several bars or rails from a single ingot. Doubtless, this would have been done long ago, had not the whole process been limited by the size of the ball which the puddler could make.

The facility which the new process affords of making large masses, will enable the manufacturer to produce bars that, in the old mode of working, it was impossible to obtain; while, at the same time, it admits of the use of more powerful machinery, whereby a great deal of labour will be saved, and the process be greatly expedited. I merely mention this fact in passing, as it is not my intention, at the present moment, to enter upon any details of the improvements I have made in this department of the manufacture, because the patents which I have obtained for them are not yet specified Before, however, dismissing this branch of the subject, I wish to call the attention of the meeting to some of the peculiarities which distinguish cast steel from all other forms of iron—viz., the perfect homogeneous character of the metal, the entire absence of sand-cracks or flaws, and its greater cohesive force and elasticity, as compared with the blister steel, from which it is made; qualities which it derives *solely* from its fusion and formation into ingots, all of which properties malleable iron acquires, in like manner, by its fusion and formation into ingots in the new process; nor must it be forgotten that no amount of rolling will give to blister steel (although formed of rolled bars) the same homogeneous character that cast steel acquires, by a mere extension of the ingot to some ten or twelve times its original length.

One of the most important facts connected with the new system of manufacturing malleable iron is, that all the iron so produced will be of that quality known as charcoal iron, not that any charcoal is used in its manufacture, but because the whole of the processes following the smelting of it are conducted entirely without contact with, or the use of, any mineral fuel; the iron resulting therefrom will, in consequence, be perfectly free from those injurious properties which that description of fuel never fails to impart to iron that is brought under its influence. At the same time, this system of manufacturing malleable iron offers extraordinary facility for making large shafts, cranks, and other heavy masses, it will be obvious that any weight of metal that can be founded in ordinary cast iron, by the means at present at our disposal, may also be founded in molten malleable iron, and be wrought into the forms and shapes required, provided that we increase the size and power of our machinery to the extent necessary to deal with such large masses of metal. A few minutes' reflection will show the great anomaly presented by the scale on which the consecutive processes of iron making are at present carried on. The little furnaces originally used for smelting ore have, from time to time, increased in size, until they have assumed colossal proportions, and are made to operate on two or three hundred tons of materials at a time, giving out 10 tons of fluid metal at a single run.

The manufacturer has thus gone on increasing the size of his smelting-furnaces, and adapting to their use blast apparatus of the requisite proportions, and has by this means lessened the cost of production in every way; his large furnaces require a great deal less labour to produce a given weight of iron than would have been required to produce it with a dozen furnaces, and in like manner he diminishes his cost of fuel, blast, and repairs, while he insures an uniformity in the result that never could have been arrived at by the use of a multiplicity of small furnaces. While the manufacturer has shown himself fully alive to these advantages, he has still been under the necessity of leaving the succeeding operations to be carried out on a scale wholly at variance with the principle he has found so advantageous in the smelting department, it is true that, hitherto, no better method was known than the puddling process, in which from 4 cwt. to 5 cwt. of iron is all that can be operated upon at a time, and even this small quantity is divided into homœpathic doses of some 70 lbs. or 80 lbs., each of which is moulded and fashioned by human labour, and carefully watched and tended in the furnace, and removed therefrom one at a time, to be again carefully manipulated and squeezed into form. When we consider the vast extent of the manufacture, and the gigantic scale on which the early stages of the process are conducted, it is astonishing that no effort should have been made to raise the after processes somewhat nearer to a level commensurate with the preceding ones, and thus rescue the trade from the trammels which have so long surrounded it.

Before concluding these remarks, I beg to call your attention to an important fact connected with the new process, which affords peculiar facilities for the manufacture of cast steel.

At that stage of the process immediately following the boil, the whole of the crude iron has passed into the condition of cast steel of ordinary quality. By the continuation of the process, the steel so produced gradually loses its small remaining portion of carbon, and passes successively from hard to soft steel, and from soft steel to steelly iron, and eventually to very soft iron; hence, at a certain period of the process, any quality of metal may be obtained. There is one in particular which, by way of distinction, I call semi-steel, being in hardness about midway between ordinary cast steel and soft malleable iron. This metal possesses the advantage of much greater tensile strength than soft iron; it is also more elastic, and does not readily take a permanent set, while it is much harder, and is not worn or indented so easily as soft iron, at the same time it is not so brittle or hard to work as ordinary cast steel. These qualities render it eminently well adapted to purposes where lightness and strength are specially required, or where there is much wear, as in the case of railway bars, which, from their softness and lamellar texture, soon become destroyed. The cost of semi-steel will be a fraction less than iron, because the loss of metal that takes place by oxydation in the converting vessel is about 2½ per cent. less than it is with iron, but as it is a little more difficult to roll, its cost per ton may fairly be considered to be the same as iron, but as its tensile strength is some 30 or 40 per cent. greater than bar iron, it follows that, for most purposes, a much less weight of metal may be used to that taken in that way; the semi-steel will form a much cheaper metal than any that we are at present acquainted with.

In conclusion, allow me to observe that the facts which I have had the honour of bringing before the meeting, have not been elicited from mere laboratory experiments, but have been the result of working on a scale nearly twice as great as is pursued in our largest iron works, the experimental apparatus doing 7 cwt. in thirty minutes, while the ordinary puddling furnace makes only 4½ cwt. in two hours, which is made into six separate balls, while the ingots or blooms are smooth even prisms 10 in. square by 30 in. in length, weighing about equal to ten ordinary puddle balls. A small portion of one of these ingots will be observed among the samples present; there is also a cylindrical mass of highly-crystallised iron, from one-half of which the 3 in. wide bar was made.

DISCUSSION UPON MR. BESSEMER'S PAPER IN SECTION G.

The President then called upon Mr. Nasmyth, the substance of whose remarks is as follows:—

I respond with pleasure to your call, and shall be happy to add a few remarks on the very excellent paper which has just been read, and at once give my most cordial and entire approval of a process at once so new, so philosophical, and so practically beneficial in its results as the process of Mr. Bessemer, which must have the effect of entirely revolutionising the manufacture of wrought or malleable iron, as at present practised.

The specimens which I see, present to my mind the most perfect and uniform appearance that it is possible for iron to assume. The disadvantage of the laminated and distinct pie-crust-like formation of layers, found in even the best of iron manufactured by the most approved means, under the ordinary system, is a disadvantage, and an inconvenience well known to engineers and manufacturers of wrought iron. Homogeneousness of structure is a most important advantage, which *is* attained by the process of Mr. Bessemer, and is beyond the question of cost or saving effected in the process of manufacture. The economy of coals per ton of iron is in itself a matter of great importance; but, that the engineer and user of iron for the various and enormously extended purposes to which that material is now employed, should have an article upon which he can rely with perfect confidence, for its uniformity of density, quality, and strength, is of much greater importance than is commonly supposed.

Look at the process for manufacturing what is called the better quality of iron, and we cannot wonder at the numbers of layers or stratifications, found on examining large masses of iron, for it is like when the housewife wishes to make a light and delicate pie-crust. It is well known she first rolls out the dough into a thin paste, then cutting it into slips or pieces, powders, or dusts with flour, the surfaces of each piece then lays the one upon the other, and proceeds to roll out the mass into a thin paste as before. Now the oxydation and impurities upon the surface of the scraps cut from a pile produces precisely the same effect; and the power of working such a mass, however great, does not free it from that pie-crust or stratified character. The enormous temperature at which Mr. Bessemer, without the application of fuel, is enabled to raise the whole mass of iron, and to thoroughly boil out and drive off all the impurities contained in the fluid metal, enables him to produce the pure, uniform, and beautiful crystalline masses of iron you see upon the table, in which state it is ready for being manufactured into bars and wrought into other forms of manufactured iron.

Having said thus much, I wish just to state one little circumstance connecting myself in some measure with the present invention; not that I wish to be understood to set up any rival claim to this invention, or to detract one iota from the credit and merit due to Mr. Bessemer, but I believe he will tell you that the present successful discovery or invention arose out of a conversation Mr. Bessemer and I had together when journeying northward by the night-train. I had been at work long before him on this most important and interesting subject, and one step in the progress of improvements which has resulted in the present most valuable one, was that which I effected by the introduction of steam in contact with a semi-fluid mass of metal in the process of puddling, the effect of which is known to most of those present who have paid attention to this subject, and if Mr. Bessemer will permit me to share in the glory of his success, even though it should be but by the reflected light from himself, I shall be satisfied therewith for the part I have acted in supplying one link in the grand chain. And I trust I shall not be misunderstood in stating at this time what I have done in connection with this invention, and I seek no more than an admission of the truth of the circumstance I have related, as having originated in Mr. Bessemer's mind the invention which he has brought before you to-day in so beautiful and so perfect a state, and having that, I am content to follow at a humble distance, or, if Mr. Bessemer will allow me, just to take hold of his coat-tails. (Applause.)

Mr. Bessemer rose and said:—What Mr. Nasmyth has stated is perfectly correct. He and I did travel by the night-train upon the occasion referred to, and our conversation turned upon the manufacture of iron. I had long conceived certain views relative to the processes employed, and I was aware how much Mr. Nasmyth had done in the way of improvements, particularly by the driving of steam into molten metal in the process of puddling, and my attention was perhaps more strongly fixed in the direction it has since assumed, and it has resulted in the process which I have described. I have, therefore, great pleasure in conceding to Mr. Nasmyth that which he so modestly asks for. I think it will be admitted that no one can be associated with that gentleman, or remain in his company, without receiving great advantage from his long and practical experience, the results of which he so obligingly, and at all times is so free to readily communicate. (Cheers.)

Mr. William Clay, of Liverpool, said, it was with great pleasure he had listened to the very interesting paper, describing the process invented by Mr. Bessemer, for the treatment of cast-iron direct from the blast-furnace, and by one operation converting it into cast steel, workable steel, or wrought iron of the finest quality, ready for the purpose of being rolled or otherwise wrought. He clearly saw the advantages appertaining to the process, the greatly increased size of the masses which could be produced, and as compared with the small-sized balls or blooms to which the process of puddling limited the production, was in itself, a vast stride of improvement, and opened out a still wider field for the application of wrought iron; for if solid masses of great size could be produced so simply and so inexpensively, there were many purposes to which they could be applied, which at the present time was commercially or otherwise impossible.

In the course of the manufacture of the great gun at the Mersey forge, his views of the construction, or making up of large masses of iron, had undergone a change, and all striæ marks, seams or fissures in wrought iron were known to be indications of weakness. Now such a process as Mr. Bessemer's, when properly systematised and commonly practised, would enable these defects to be entirely got rid of; but there was another phase of the question which was equally worthy of their attention, and for which alone Mr. Bessemer deserved the best thanks of all iron manufacturers, for it would enable them to get rid of the most troublesome set of men with which any manufacturer was cursed, and in a humane point of view, also, this would be a great blessing, for who that has had anything to do with puddlers does not know to their cost how much they are, as a class, the masters of their employers, and how the production of wrought iron is strangled, or at least limited and governed, by this small but hitherto important body of men. The very limited size of the mass of metal which can be worked in a furnace by the strongest puddler, is a true indication of the very limited character of that operation, whilst the great exertion and endurance of fatigue which the puddler has to undergo, renders it most desirable that that operation should be superseded; and, he added, I hail with delight the inauguration of a new system of manufacture, which will not only supersede and render unnecessary the puddler and the process of puddling, but which also effects other great and important improvements and economy in the most important branch of industry of this great country.

Mr. Budd, of Yestelevera Works, South Wales, said he quite agreed with the remarks which had been made by the previous speakers, and, as a practical iron manufacturer, was glad to find the process of Mr. Bessemer so simple, economical, and thoroughly efficient. He looked upon those specimens of refined irou produced direct from the blast furnace, without the employment of fuel, and also the specimens of bar iron, &c., made therefrom, as the inauguration of a new and a better system; and he hoped that Mr. Bessemer would prosecute his investigations and experiments as far as possible, and that he would reap the full benefit and reward which should be derived from such an ingenious and practically useful invention.

Mr. Exall, of the firm of Messrs. Barrett, Exall and Andrewes, engineers, &c., of Reading, said, as a manufacturer and extensive user of iron, he had great pleasure in stating that the importance and advantages claimed for Mr. Bessemer's process, as described in the very interesting paper which had been read, and which had received confirmation from so many practical men during the discussion in this section, had not at all been over-stated or exaggerated; for a more important improvement connected with the manufacture of iron had not been made since the days of Cort; and it was curious to observe the coincidences connected therewith, as attention was only now being extensively attracted to the neglect which the inventor of that important improvement suffered during his lifetime in connection with the introduction of this invention, the extensive use of which, and the vast benefits derived therefrom by the ironmasters of this country, was now a matter of history. He quite agreed with Mr. Clay in the humane view of this question with reference to the puddlers, and no one more than himself would be glad to see the iron trade freed from the thraldom of the puddlers, who practically ruled the manufacture of wrought iron, and limited the quantity produced. All processes which are more economical, and render a manufacturer independent of the caprices of those employed by him, and which at the same time produced a more uniform quality, and greatly increased quantity of so important a staple article of this country, and a requisite of the whole civilised world, must be of world-wide importance, and deserving of our best attention and the thanks of this section to Mr. Bessemer.

And whilst he wished Mr. Bessemer every success, and that he may derive all possible pecuniary advantage from the introduction of his valuable invention, still he looked somewhat uneasily, and with no small concern, at the prospect which might arise to the users of iron if Mr. Bessemer permitted a monopoly of his process by one or even a few iron-making firms; and large and immediate as might be the gain to Mr. Bessemer if the right to use a process was bought by certain parties for a large sum of money down, he trusted that Mr. Bessemer would not adopt such a course, but would throw the patent process open to the entire trade at a fair royalty; and he begged of Mr. Bessemer seriously to consider his suggestion, for otherwise he feared that what had been said of patents generally might apply to Mr. Bessemer's case, and demonstrate that a patent granted for a great and important invention was only a bait for the unprincipled and piratically-disposed, and served as an introduction to a legal sea of trouble.

The President said, he regretted that the time and the number of papers which had yet to be read, compelled him to close the discussion upon a paper so full of interest, but he had great pleasure in conveying to Mr. Bessemer the cordial thanks of this section for the very interesting paper which he had read, and he agreed with those who had previously spoken, in hoping that Mr. Bessemer would reap from his invention that solid and substantial reward to which he was so eminently entitled.

DR. GREENE'S PAPER ON A NEW RAILWAY BRAKE.

Invented by M. Sisco, Paris.

This brake, as described by Dr. Greene, and as illustrated by a model of a four-wheeled under-carriage, consists in arranging four cams, or eccentric drums, with deep flanges, each having a tangential lip-piece, which forms the skid, and which, when turned down on to, or in contact with the rail, becomes wedged under each wheel, and so converts the carriage into a sledge. The four eccentric drums are mounted upon axles placed in front of the bearing-wheels; two long connecting-rods, or bars, running along the sides of the carriage, connect and cause the four drums to work simultaneously.

The President having invited members to make observations upon the paper just read, several scientific gentlemen present drew the attention of the President and the Section to the fact that very similar plans had already been tried in this country without success; and that there were many practical and serious disadvantages belonging to the plan described by Dr. Greene.

Amongst the objections heard, and which we took occasion, previously to the reading of the paper, to point out to Dr. Greene and the members of the committee, were the following, viz.:—that the great additional weight of the apparatus described, as compared with the ordinary brake blocks and gearing, could only be used whilst the carriage was running in one direction: that the train must be backed before the brakes could be taken off: that the action, being instantaneous, the shock would be violent and injurious: that the action of the cams, or eccentric drums being, when thrown into action, like a heavy hammer striking the rails, their use would be highly injurious to the metals and the permanent way, and we entirely agree in the condemnation bestowed upon the plan.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(From our own Correspondent.)

Southampton, August 21st, 1856.

The negociations for the purchase of the large vessels of the General Screw Company by the Societé Génerale des Clippers Français, have abruptly terminated, in consequence of the inability of the latter company to furnish the necessary capital. Thus the deposit-money, £25,000, has now become the property of the General Screw Company, and their ships are again on the market. It is rumoured that a Russian company, eonnected with the Government, are in treaty for their purchase. The greater part of this fine fleet is now in our inner dock, aud it must be a subjeet of regret to every one interested in the progress of steam navigation that some field for eommercial enterprise should not be discovered for their profitable employment by their present owners.

The General Screw Company were among the first to recoguise the advantages of the screw-propeller; and their earliest vessels of small class, such as the *Lord John Russell*, *Sir Robert Peel*, &c., &c., gave excellent commercial results when running from London to Rotterdam, and other continental ports; but the extension of the company's operations with the present large class vessels to Australia and the East Indies was produetive of loss and disappointment. The large sums of mouey received for transport service has, however, retrieved the losses so caused; and should a satisfactory sale of the vessels be effected, the shareholders will no doubt be in a better position than eould have been antieipated before the outbreak of the war.

The Southampton Doek Company have lately made considerable additions to the quay room and accommodation for vessels; and, at a meeting held in London yesterday, declared a dividend at the rate of £4 per eent. per annum.

The European and Australian Steam Compauy propose dispatching their first vessel, the *Oneida*, from our port some time next month; she has been engaged during the war as a transport, and is now refitting her machinery, and being adapted for her new trade, in Glasgow. A description of her machinery has been given in a previous number of THE ARTIZAN, and therefore nced not be here repeated.

We understand that this eompany have also purchased two other steamers, the *Columbia* and *European*, lately transports in the French Government service, which are to follow the *Oneida* to Australia.

The new vessels building for the company in Glasgow are stated to be two of 2,000 tons and 600 H.P. for the line from Southampton to Alexandria, and one of 2,800 tons and 650 H.P., to run with the boats before named from Suez to Melbourne.

These new vessels are announeed to have a *guaranteed* speed of 14 knots per hour when fully coaled.

The South Western Steam Packet Company have lately plaeed two new paddle-steamers on their line from here to Havre, named the *Alliance* aud *Havre*. They are of iron, by Mare and Co., of Blackwall, and have Scaward's patent atmospheric engines.

We subjoin thc dimensions of the *Alliance* :—

	Ft.	In.
Length from fore part of stem to after part stern-post	175	$\frac{5}{10}$
Breadth over wales	23	$\frac{7}{10}$
Tonnage (register 168 $\frac{46}{100}$)		
Do. (gross... 360 $\frac{85}{100}$)		
Draft of water, light, 7·9 forward, 8·9 aft.		

As some of our readers may not happen to be acquainted with the distinctive peculiarities of the cngines of these vessels, we may state that there are three open-topped eylinders, standing vertical, and immediately below and in a line with the crank shafts, and are bolted to each other as closcly as possible. The conneeting rods proceed directly from the pistons to the crank pins, and the pistons are guided by round rods passing through guides bolted to the cylinder tops. The crauk for the centre cylinder is of course formed with a double throw in the intermediate, similar to those uscd for working the air-pumps of oscillating engines, but of coursc longer in the throw and stronger, as it has to receive the strain of a largc steam cylinder.

The slide valves are on the gridiron principle; to reduce their stroke, each eylinder has one steam valve and one exhaust valve; they are worked by cams on the crank shafts, instead of the usual plan of eccentrics.

The *Havre* has two air-pumps, worked from the wing pistons by short links and beams, which also work the feed and bilge pumps. This plan is an improvement on that of the *Alliance*, in which the pumps are plaeed at an angle, and worked by a second crank of diminished stroke, formed out of the solid of the cranks on intermediate shafts.

A natural objeetion to this plan of engine will at ouee oeeur to our readers—viz., the use of three large cylinders (with open tops, ready to receive as much dirt, dust, &c., as may chance to fall into them), when, as the alternative is to be found in the ordinary oscillating or trunk engine, which, with two cylinders of considerably smaller dimensions (in this ease they would each be $8\frac{3}{4}$ in. less diameter), would give out the same power, take up less room, and be considerably lighter.

Messrs. Seaward, however, eonsider that an advantage is gained by the uniformity of motion obtained by three cylinders, and the high degree of expansiou of steam this enables them to carry out, resulting in eeonomy of fuel. And with regard to the objections to open cylinders, they point to the steamer *Wonder*, belonging to the South Western Company, which, with similar engines, has been successfully at work for years, without any serious wear in her cylinders and pistons.

DIMENSIONS OF ENGINES OF "ALLIANCE" AND "HAVRE," OF 220 NOMINAL H.P.

Diameter of cylinders	$62\frac{1}{4}$ in.
Stroke of piston	4 ft. 6 in.
Revolutions when light	
Steam pressure in boilers	16 lbs.
Vacuum	27 „
Average time on passage to Havre, a distance of	$9\frac{1}{4}$ hours.
Giving an average speed of miles per hour.	
Average consumption of Welsh eoal to Havre and back, including laying fires..	24 tons.
Gross indieated H.P. on trial	857
Common paddle-wheels	21 ft. diameter.
Twenty floats	8 ft. × 2 ft.

PATENT SELF-ACTING DOUBLE-TRAVERSING DRILLING MACHINE.

By SHARP, STEWART, and Co., Manchester.

Illustrated by Plate lxxxiv.

WITH the present Number we present our subscribers with a plate exhibiting three views of this excellently-arranged machine, which will be fouud a valuable addition to the machine-tools of the Engineer.

As an economieal tool, the double machine possesses many advantages; as when properly set, picees of work and parts of machines requiring slots or grooves drilled in their ends with perfect accuracy, as to their relative positions aud dimensions, such, for instauce, as steam-engine counecting-rods, and similar articles, ean be drilled iu the same time, and with the attention of one workmau or attendant.

For cutting the key-beds of railway axles, machine shaftiug, and such like work, the exact parallelism and depth of the slot which is thus insured, is au important advantage.

For cutting slots of great depth, and at each end of a piece of work at the same time, the machine will be found particularly useful, as, by mounting the work upon the tables with set screws or gauge clamps, the work may be drilled first from one side, and then be turned over and drilled from the other; whereupon, the holes thus formed will meet accurately, and the risk of breakage, so common to the use of very long drills will be thus avoided.

The double-drilling machiue is so contrived that both head stocks may be employed in drilling the opposite ends of the same piece of work, or they may be forming slots, or one of the head stocks may be employed iu drilliug the other in slotting, and each is self-acting, together or independently.

We have seeu some of the work produced by these machines, and the slots formed iu the end of connecting rods, and their straps are certainly more true and free from irregularities, indentations, or other defects, than similar work produced by the ordinary drilling or slotting machines, when finished up by chipping and filing.

For slotting and drilling piston-rod ends, cross-heads, and such like parts of engine work machinery, these machines will be found of great value.

For cutting oil cup and other chambers out of the solid, as, for instance, in eccentric straps, connecting-rod straps, and similar articles, whether of circular or rectangular form, these machines do their work admirably.

There is one other purpose, however, for which these machines will prove of inestimable value. Those who have had to produce broad and deep spiral grooves around a cylinder or cylindrical bar, well know the difficulty of doing so with the ordinary tools at their command, even in factories best supplied with machine tools. In these machines spiral grooves or slots can readily be produced with perfect accuracy and great rapidity, of any pitch, by means of suitable chucks fixed upon the tables, the cylinder being caused to revolve slowly, and in correct proportion, by means of a worm and wheel geared into and driven by the main shaft of the machine; and not only may a spiral groove of uniform pitch be produced, but a varying pitch may be quite as easily produced.

A careful inspection of the details of Plate lxxxiv. will enable our readers to understand the construction of these machines. It will be seen that there is mounted upon a long cast-iron bed two traversing head stocks, which have a range of travel corresponding with the length of the bed, and they receive a reciprocating motion, separately or collectively, by means of connecting rods attached to revolving discs, or plate wheels; these are fixed under the two ends of the bed. The slots which regulate the distance of travel, and so refine the length of the slot required to be cut, have a traversing stud and set screw, as in the ordinary slotting machine. The speed of the discs or plate wheels can be changed at pleasure.

Drilling spindles of the head stocks have a self-acting feed motion, by which the drills are caused to descend at each end of each slot simultaneously with the traverse of the traverse motion, and the drills are so geared as to revolve at speeds varying with the diameter of the drill or cutting tool in use.

It will be seen that there are two tables upon which the work to be operated upon can be readily and accurately set, and when once adjusted to the dimensions and form of the cut required, need not be altered; and as these tables are somewhat like a compound slide-rest, the variation in the line of cut, and the changing form or surface of the object to be acted upon, can readily be produced, or allowed for.

The very small space which we can afford in the present Number for noticing this invention, and other subjects of interest, compels us to defer, until next month, any further remarks upon this very useful and ingenious tool; but we propose to conclude our remarks in our next, and, at the same time, give some examples and illustrations of the work performed by these machines, as also a description of the cutting instruments employed.

THE NAVAL PREPARATIONS MADE BY RUSSIA FOR THE PURPOSE OF RESISTING THE EXPECTED ATTACK OF THE ALLIED FLEETS IN THE SPRING OF 1856.

It is now a matter of great interest to the general public, as well as to those who were actively engaged in the naval operations undertaken during the late war, to know what course Russia intended to take with reference to the introduction of steam into the line-of-battle ships, and in the formation of a fleet of gun boats, and such-like craft, suitable to cope with the enormous steam-propelled fleets of the Allies.

Very recently, Admiral Sir C. Napier paid a visit of inspection to the fortifications of Cronstadt, and was permitted to examine them minutely. What the gallant Admiral saw, and what opinion he formed of these and the other defences of Russia—of her fleet and her naval and military *matériel* resources — will be found by reference to his communications recently published in the "Morning Advertiser."

We, too, have had the advantage of the opinion of an eminent practical engineer who recently visited St. Petersburgh, Cronstadt, &c., and was present at the naval review.

Considering the comparatively small means the Russian Government had at their disposal to construct and equip a steam fleet of gun-boats, &c., to compete with those of the Allies, it will be interesting to learn the number of vessels fitted with screws which they would have got ready by this year's campaign in the Baltic. Although the figures seem very small, compared with what has been done by the English and French Governments, it must be remembered that whereas they are the greatest mechanical countries, the Russians hardly ever made a marine-engine; and the exertions and energy exhibited by the Russian officials deserve the highest praise.

In a review which lately took place at Cronstadt, the whole of the gun-boat flotilla, as well as the line-of-battle-ships and frigates, were under inspection. There were from forty-five to fifty steam screw gun-boats quite complete for sea; these boats draw about 7 ft. aft and 5 ft. forward, and are fitted with engines of 80 H.P., placed diagonally in the vessel, and of somewhat similar construction to those made in Sweden, and exhibited at the Paris exhibition. They have two boilers, about 4 ft. diameter; they mostly carry three guns, two of 96 cwt. and 68-pounders, and one long 36-pounder. The speed of these boats is from 8 to 9 knots per hour. The outward construction and appearance of them much resemble those constructed for Government, but they are lower in the water, and have sharper bows. They seem more adapted for river navigation than for sea service, and have not such a substantial appearance.

There are in all seventy-five of them in course of construction.

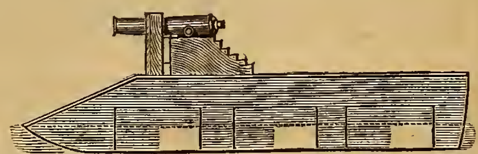
There are also some twelve or fourteen screw steam-corvettes, fitted with high-pressure engines; but it seems that only two of these would have been ready for this year.

Besides the above, there are under construction fourteen floating batteries. The batteries are constructed with only one fighting side, the guns being some 5 ft. out of water.

The face of the parapet of these batteries is lined with 4 in. thick iron down to the level of the platform, from whence there is a long slope to the water's edge, which is lined with only 1 in. thick iron, as it is supposed that the shot, striking in an angular direction, would glance off without entering the iron. They are floated by three long square boxes, which are under the platform of the batteries.

The gunpowder is kept in these under the water-line. Each of the batteries are provided with four heavy 68-pounder guns, excellently arranged for being worked rapidly with the least power.

The annexed engraving exhibits a transverse section of these batteries.

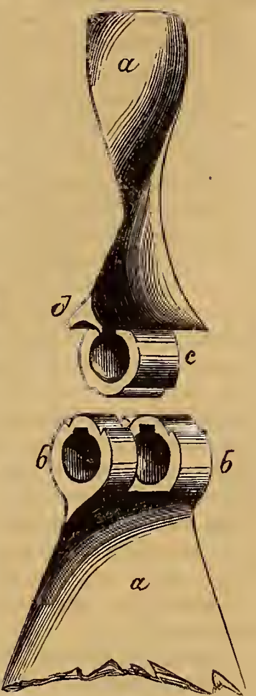


At the present time, the Russians have but one line-of-battle ship fitted with a screw propeller: but it is generally understood that it is their intention to fit a large number of their line-of-battle ships and frigates with a screw propeller, and some of the steam-engines and machinery are now being constructed at the Government works at Kolpeny, and others are being made by the constructors of the gun boat engines.

It should not, however, be forgotten that, in addition the above, there are numerous sailing and row gun boats, no correct numbers of which, however, could be ascertained, and the eye had great difficulty in counting them whilst in motion during the recent review below St. Petersburgh.

LYNN'S IMPROVEMENTS IN THE SCREW PROPELLER.

Mr. William Lynn, Assistant Inspector of Machinery of Her Majesty's Dockyard, Portsmouth, has recently patented a simple but important improvement connected with Screw Propellers, which we have much pleasure in presenting to the notice of our readers at the earliest opportunity.



Want of space, in consequence of the great number of interesting papers read at the British Association, and reported in our present Number, alone prevents our giving as full a notice of this invention as it deserves.

These improvements refer to a novel mode of constructing the blades of screw propellers, by which they may be separately fitted on to or removed from the shaft, for the purpose of being replaced in case of damage, or from any other cause, and by which peculiarity of construction spare screws can be more conveniently stored or carried on board of ship.

Instead of easting the blades of the screw together with the boss and shaft, or, as is frequently done, casting them solid with the boss, the eye of the screw being afterwards bored and fitted on the shaft, these improvements consist in casting the blades separately, with a portion only of the length of the boss or eye cast therewith, and afterwards fitting the parts of the boss together in such a manner as to secure them to the shaft, and form a solid screw, when keyed up or fixed by collars.

Thus, for instance, in applying this invention to a double-bladed screw, the boss is formed in the manner of jointing hinges, viz., with a knuckle joint, as shown in the accompanying diagram.

The boss being divided in its length into, say four parts, the male portion is formed in the middle of the boss of one blade, and is about 3-4ths of the whole, whilst the other blade has the female portions of the boss, divided into two lugs or eheeks, each of about 1-4th the male and female portions of the boss, being accurately fitted together ; the eye is made to receive the screw-shaft, or T headed piece of shaft, upon which it is fitted, and may be secured by means of a feather.

In the accompanying diagram, A is the one blade, having the single knuckle or male portion of the joint, C ; A is the corresponding blade, having the double knuckle, or female portions of the joint, B, B ; D is the shoulder of the single knuckle or male portion of the joint or boss, C, and which abuts on and forms a stop into the recess formed upon the top sides of the double knuckles, or female portions, of joints or boss, B, B.

AMERICAN NOTES.—No. IX.

STEAM NAVIGATION.

Portland and Liverpool.—An effort is making to establish a line of steamers between Portland and Liverpool, touching at Halifax. A company formed in Halifax with this object propose to buy two iron propellers of 1,700 tons burthen. A public meeting was recently held in Portland, to secure the co-operation of citizens.

Vanderbilt's European Line.—The engineer's trial of the new steamer of this line, the *C. Vanderbilt*, took place on Saturday (July 19). As she is not yet finished, invitations for the occasion were issued only to the mechanics employed upon her, members of the press, and a few others. A more formal trip, with reference to the sailing qualities of the vessel, will be made at a future day. The trial was satisfactory in its results. She left the foot of Corlears Street at 4 p.m., and after some little delay in getting into the stream, went about a mile beyond Fort Hamilton, and returned to the city early in the evening. Her engines worked very smoothly; the number of revolutions, at a moderate pressure of steam, reaching thirteen a minute. Her draught, with 500 tons of coal on board, was 17½ ft.

The principal dimensions and equipments of this vessel have been already published, but the following contains some interesting statistics not yet in print.

Weight of hull, 2,300 tons ; registered tonnage, 3,900 tons ; actual measurement, 5,100 tons ; load draught, 19 ft. 6 in. ; dip of wheels at load-line, 8 ft. 6 in. ; four boilers, 30 ft. long, and weighing 60 tons each, presenting a boiler surface of 20,000 superficial ft. ; thirty-two furnaces, and stows 1,400 tons of coal.

The hull (built by J. Simonson) is constructed in the staunchest manncr. The work was done by the day, under the immediate supervision of the owner, Commodore Vanderbilt, who has spared neither time nor expense to produce a good specimen of marine architecture. Her floors are bolted fore and aft, edgewise, with 1¼ in. iron bolts, from 6 to 8 ft. long. The floors are fastened through the keel with 1⅝ in. copper bolts, two in each timber. Total weight of bolts 50 tons. The second and third fattocks are of white oak, and the third and fourth of live oak and locust, in nearly equal proportions.

The vessel is iron, strapped throughout, having 350 diagonal straps, each 40 ft. long, 5 in. wide, ⅞ in. thick, and weighing together about 96 tons. The planking on the outside of the ship is of white oak, thoroughly fastened with copper bolts and locust treenails. There are five decks, three extending the entire length of the vessel. She is divided into sixteen water-tight compartments, the bulkheads being very strongly constructed.

The main dining saloon aft is 108 ft. long, 25 ft. wide, and 8 ft. high, with twenty-nine state rooms, two berths and a sliding berth in each. The state rooms are 6 ft. long, 8 ft. 10 in. wide, and about 8 ft. high, with berth rooms attached. The cabin is finished with oak, in the oriental style. The panel work of the state rooms is oak veneered on pine. Nine state rooms open on both the larboard and starboard gangways. There are also five state rooms beyond the aft pantry. The forward dining saloon is fitted up in the same style as the aft, with the substitution of pine for oak. In this there are forty-five state rooms, and 138 berths. Forward is another cabin, with thirty-three berths. The upper saloon is 258 ft. long and 30 ft. wide, with forty-one state rooms, and forty-six berths. This saloon is fitted up in an elegant and substantial style. 500 passengers can be accommodated in all parts of the ship, and she is furnished with eight life boats, each computed to carry 100 persons.

The captain is Peter C. Lefevre, formerly of the *Ariel.*

The total cost of this vessel is not far from 800,000 dols. Her machinery alone (from the Allaire Works) cost 220,000 dols.

COLLINS' LINE.

The Adriatic.—In my Notes for June last (No. VI.) I am made responsible for an article regarding the launch of this vessel, which I furnished you as an *extract.* Now, as the language and opinions there given may not be approved of by me, I beg leave to enter a dissent to their being assigned to my paternity.

The following are some interesting and additional elements regarding the vessel :—

DIMENSIONS, AND OTHER STATISTICS.

Length over all	351 ft. 8 in.
Length on load-line	343 ft. 10 in.
Breadth of beam (molded)	48 ft. 8 in.
Breadth of beam (extreme)	50 ft.
Depth of hold from underneath spar-deck	33 ft. 2 in.
Area of greatest transverse section at 20 ft. draught	880 sq. ft.
Displacement at 20 ft. draught	5,233 tons.
Weight of hull	2,041 tons.
Launching draught	10 ft. 2 in.
Weight of engines, boilers, water, coal, spars, &c.	2,200 tons.
Average displacement per inch from launching draught to light load-line (17ft. 1½in.)	26$\frac{7}{10}$,,
Average displacement per inch from light load-line to 20 ft. draught	28¾ ,,
Draught of water at a displacement of 4,241 tons	17 ft. 1½ in.
Average displacement from 20 ft. line to 21 ft. 6 in. (per inch)	31½ tons.
Displacement at 21 ft. 6 in. water-line	5,800 ,,
Number of cabin passengers	300 ,,
Cost of copper bolts and fastenings	70,000 dols.
Galvanising iron bolts	9,500 ,,
Estimated cost of entire ship	800,000 ,,

Steam-boat, Fraz Skiddy.—In order to meet the requirements of great burthen and a light draught of water, the proprietors of the New York and Albany line of steamers have within the past year adapted their boats, the *New World* and *Isaac Newton*, to the increased traffic ou this route by widening the former and lengthening the latter, the particulars of which have been furnished you. I have now, however, to advise of the last undertaking of this line in the way of adding to the capacity of a steam-boat which, for its novelty, is worthy of a record. She has had an entire new hull built over her old one, which makes her the lightest draught passenger steam-boat that floats on the Hudson river. The draught of water, with passengers and freight on board, is 4 ft. 6 iu., 2 ft. 6 in. less than formerly, which will enable her to cross the shallowest bars at any time. She has also had a number of large and commodious state rooms added.

This boat, in point of speed, stillness of movement, excellence of accommodations, and all other appointments, everything considered, is certainly superior to any other steamer on the river. She will give accommodation to between 400 and 500 passengers. The state rooms are all of the first class, with abundance of room, good ventilation, excellent beds and magnificent furniture. On the third deck state rooms are finished for the officers aud crew of the boat. This deck, some 40 ft. above the water, has also been fitted for the occupancy of passengers either for sitting or promenade.

Another point worthy of particular note is the fact that the vessel is a boat within a boat: in other words, she has two complete and perfect hulls, the space between them being about 7 ft., so that in case of the severest collision, the inside hull would afford perfect protection to passengers. This feature of safety will be properly appreciated by the public.

CORRESPONDENCE.

To the Editor of The Artizan.

Sir,—I have read Mr. R. Armstrong's remarks on "The Causes and Remedy of the Unprofitable State of Shipbuilding," and agree fully with his observations, but I think he overlooks a very important point connected with his subject, namely, the absence of practical knowledge on the part of any one of the large shipbuilders on the Thames. I do not believe there is one among them who could take the tools out of his workman's hands and show him how to do his job; and when this is the case the man is sure to be master. Look at Sheffield, where the men control their employers to a greater extent than in any town in the kingdom; there all the great employers are merchants, and know no more about making steel or cutting a file than their own daughters; hence they are completely in the hands of their men.

The engineers withstood the unreasonable demands of their men, because such employers as Mr. Penu, Mr. Field, and Mr. Miller are not only first-rate workmen themselves, but are each capable of making machiues to do the work of these men, and able to instruct labourers how to use such machines in a few hours.

Master shipbuilders, before they can arrive at the position of the master engineers, must take more interest in the details of their business, and make it a pleasurable hobby as well as the means of obtaining money. I am, Sir, yours truly,

A Working Man.

A PAPER ON THE PATENT LAWS.

By W. A. Macfie, Liverpool.
Read Tuesday, 12th August, 1856.

The following letter from Mr. Macfie was read :—

Liverpool, 5th August, 1856.

Dear Sir,—I hoped to have been able to attend the British Association, but must relinquish the expectation for this week. It was my wish to bring before you and other office-bearers and members of committee the question—How far it is prudent for a scientific body, such as ours, to take up the subject of the Patent Laws? I fear the answer must be in the negative. Such being my view, I strongly counsel a course of extreme caution. There is reason to apprehend that if the course on which the Association has entered be followed on, the Association will commit itself to extreme one-sided measures. Personally, I have no wish to combat the alleged right of property in inventions. I fancy *that* property is the creature of State enactments. It may be legitimate, or even wise, to constitute property of that kind for a limited period; but I regret to find, from what has been printed iu relation to the proceedings of the Association, that even among the followers of abstract science a theory has been propounded, and principles of legislatiou proposed, which would subject the commerce and manufactures of this country to burdens and restrictions that I, for one, being practically engaged in manufacturing, cannot contemplate, without uneasiness, for the consequences.

If the Association pursue the matter further, I respectfully submit it should abstain from undertaking, itself, the advocacy of one side or other of an unsettled question, and should, at least, give no countenance to the idea of *monopoly* which the present law confers on patentees. Surely, it would be much better for the country that *all* parties subject to competition iu home or foreign markets, should be at liberty to use every invention as soon as published, on payment of a reasonable money consideration, for a limited term of years, sufficient to afford the inventor a due reward for making his discovery known.

I hope you will kindly excuse the freedom of these remarks.

To the President of Section G. I am, &c.

Mr. Macfie, however, did attend the meeting of section G, on Tuesday, 12th August, when he, in continuation of the subject, read the following paper, calling particular attention to the following extracts :—

The following extracts, from the "North British Review" for November, 1855, show that the British Association requires to be very careful, lest unauthorised versions of its decisions go forth and prejudice this great body, the position of men of science, and the commercial welfare of the nation.

"This monster evil is the Patent Law of England—the scandal of modern legislation—the drag upon the industrial progress of England—the millstone round the inventor's neck—the spoiler who first robs, then insults, and, finally, ruins him."

Alluding to the recent measures of reform, the writer proceeds :—

"The Committee of the House of Commons, however, under the corrupt influence of interested parties, introduced alterations," &c.

Then follows a complimentary allusion to Mr. Webster, which, in this assembly, it is quite unnecessary to repeat. An account is then given of the proceedings of the British Association, and of the discussion at Glasgow last year, on the general subject of the Patent Law, and next comes the following paragraph :—

"It must now be obvious to our readers that, in the opinion of disinterested and intelligent individuals, and even of associations and public bodies" [pointing to the British Association principally, of course], "a radical change in the Patent Law has become necessary; and that this change must consist in making patents cheap and secure—in greatly extending their period—and entrusting the administration of the law to a scientific board."

The desired extension of period appears in the followiug passages :—

"The brief endurance of a patent right, only fourteen years," &c.

"With these principles in view, we are now prepared to consider what interests are at stake, and what injury would be done to them, by making patents and copyrights perpetual."

A strauge proposal certainly, yet oue the writer of the article seems to entertain, for he supports it by a principle utterly fallacious, illustrated in the following passage :—

"Mr. Nasmyth, we venture to say, would supply steam hammers cheaper and better than any manufacturer in the world; and it could be proved, from numerous facts, that instruments constructed by persons not employed under a patent, are less cheap and less perfect than those who are."

It is unnecessary to multiply extracts. Those presented are sufficient to suggest to us the necessity for cautious procedure. Their importance is chiefly derived from the eminence of the scieutific gentleman to whom the authorship of the article is attributed. I submit that the Association may occupy a more dignified position.

It appears to me that neither to the extreme to which the justly respected writer of these extracts pushes his favour for patents, nor to the other of declaring war against patents altogether, "*tentans vitare charybdin*," should this Association lean. It should either calmly represent the system (as now administered) to be liable to specific objections, without judging *how* far the other side—for sides there are—may have equally strong objections to urge; *or*, it should avoid the subject altogether. I fear that the attempt to make this Institution a lever or advocate for attaining even a good end not strictly within its scope, is fraught with danger.

As one of the manufacturing portion of the community, I desire to disavow all wish to be unthankful to inventors, and unjust by refusing them what is fair and kindly; but then, in sacredly protecting rights on the side of the thousands, I must be mindful of the millions. We are accused of being interested—we *are* interested—"this is not the cause of party or of faction, but the common interest of every man." If the patent system be so framed as *not* to facilitate or cheapen manufactures, then it is the common interest to get rid of it, unless it can be improved. The main evils *as regards the public* (and it hardly serves inventors even as it might) are: 1st. The monopoly, and under it the want of limit to the *reward* which patents are intended to offer (for publishing new discoveries, and for public advantage anticipating the natural course of events, which no doubt moves towards a development of such things sooner or later, and so far practically introducing a new art); and, 2nd, the extreme facility and utter want of discrimination in granting patents, causing hindrances to manufacturers, which I cannot think very different from what a traveller would experience if, at every turn of a business journey he were stopped by innumerable closed toll-bars with undefined charges, at some of which he was called upon to pay, and at all of which he is liable to be pulled up (or rather to pull up); and perchance, if the collector, negligent or determined, *keep* the bar across the road, must turn back, or else go round some less convenient way.

It is to the first of these evils I wish chiefly to advert at present; and to exhibit the case more clearly, let me ask you to conceive the patent-fee (if the monopolist consent to sell his licence), to be payable on *processes* or *goods* rather than on machinery. A royalty is claimed, it may be, at the patentee's option, a high or a small per centage; but even if it be a small one, profits are also a small per centage. Now this state of matters might have done in days gone by, when there were protective duties; but now, when unrestricted competition is the order of the day, the keen rival may dwell in a foreign country where there are no patents, or where the inventor has failed to secure a patent. But, to make the anomaly of our legislation more striking, this rival may be in our own colonies, in some part of the British dominions where our liberal and paternal Government has allowed exemptions from all patents—that is, where the benefits from eliciting discoveries are conferred to the full; whereas the burden of rewarding the discovery is thrown on manufacturers at home entirely. I can even conceive a patriotic Frenchman, of oblique vision, no doubt, *refusing* to treat with British manufacturers for a licence under his British patent.

A remedy for these evils appears to me to be, to throw open to the use of all the nation each new discovery *as soon as published*, and let the inventor have the right to tax all who use it, the onus of finding these out to rest with the patentee, for which purpose he should be invested with power to give rewards to informants, and to ask every person supposed to be using the plan whether he is doing so or no.* If thereafter the parties cannot agree upon terms, arbitration to be compulsory; the referee, however, being entitled to take into account the existence of foreign competition, and the non-existence of patents, especially if that non-existence be the result of negligence, in competing countries, where such circumstances are proved.

The irregularity in the remuneration of inventors presents very remarkable matter for observation. Let me illustrate this by Messrs. Manton and Alliott's ingenious Centrifugal Drying Machines. It was an easy step to *apply* this invention to sugar (for patents are given for new applications), a patent, however, being granted, something like the following happened; whereas the charge of the inventors of the machine was a few pounds, the pretensions of the assignees of the mere appliers were for *thousands*. It is worth while to note the result: the West Indians became so clamorous against patents altogether, that they got the British Parliament and Government to emancipate from these bonds every colony that should express a wish to be free.

Before concluding these imperfect "hints," let me add, and this I do without impugning the rights of inventors, or the honour of a contrary procedure, we may well bear in mind that there is something *nobler* than the securing and profiting by patent rights—a way that the Association should not discourage by any means. I allude to the giving the nation the discovery unconditionally and absolutely.

* This may appear at first sight to involve others. It may be objected to as inquisitorial. I might endeavour to show the contrary, but I do not stop to do so. No claim for use to hold good until personal notice be served.

ROYAL SCOTTISH SOCIETY OF ARTS, JULY 14, 1856.

3. *Description of an apparatus for seeing through Tubular Drains from the Surface of the Street.* By James Leslie, Esq., C.E., Vice-President, R.S.S. Arts. A model and drawings were exhibited.—The apparatus exhibited, which may be considered as a model on half the scale which it would be expedient to adopt in practice, is for the purpose of affording the means of seeing, from the surface of the street, through underground tubular drains, which are too small for a person to pass through, and thereby enabling the observer, without his requiring to go down into any underground chamber, by looking towards a lamp or candle lowered down to another point in the line of drain, to see whether there be any sediment or other obstruction in the portion of the drain between him and the light. This is effected by looking down with the help of a telescope of small power to a mirror, set at an angle of forty-five degrees in the lower end of a light metal tube, say 6 in. diameter, and lowered down from the surface of the street to the axis of the drain-pipe through a fixed vertical pipe or eye, a light being lowered down another and similar vertical pipe, whereof there must necessarily be one at every bend or change of gradient in the drain.—Referred to a committee.

4. *Suggestion for the introduction of the Parisian "Crochet," for the use of Street Porters.* By Colonel Graham, of Jarbruck, Moniaive.—This was a suggestion for the introduction, for the use of street-porters, of what, in Paris, is called a *crochet*, a very simple and cheap contrivance (as one can be constructed for 2s. 6d. to 5s.), curved on the back, which has the effect of throwing the load off the spine and causes it to rest on the limbs, thus enabling the porter to travel much more comfortably even under a greater load than that usually carried in this country.—Mr. Sang remarked that a somewhat similar machine, of even simpler construction, was in daily use in Constantinople, and that it was astonishing how great a load a Turkish porter can carry, the pressure being thrown entirely upon the limbs and not on the spine.—Thanks voted to Colonel Graham.

5. *Descriptions and Sketches of Three American Registered Kitchen Ranges or Cooking Stoves.* By Mr. James Smith, 85 Union Street, Glasgow.—A model and some of the stoves were exhibited.—The advantages of these stoves, or portable ranges, were stated to be their peculiarly compact formation, affording, at a comparatively small cost, nearly every opportunity for all the varieties of cooking possessed by the most expensive and complicated ranges, insuring also a very small consumption of fuel, with cleanliness and saving of labour to the cook. The heat from the small fire in the front part of the stove is made to pass under various boilers and pots, and then, by a peculiarly simple arrangement of the flues, to pass round and uniformly heat the oven, which occupies the body of the stove, before passing up the vent. They are made of cast-iron, the fireplace lined with fire-clay, are handsome in design, and are furnished with all the necessary cooking utensils for family use, and require no fitting or building in.—Thanks voted.

6. *Notice of the American Apple-Parer.* By James Alexander, Esq., late of Frederick Street, now of Toronto, Canada. The machine was exhibited in operation.—This very ingenious and simple machine (of about 9 in. by 5 in. in size) excited much interest, from the efficiency and celerity of its operation. It pares an apple or any other body of about the same size, adapting itself to all sizes, from about 1 to 3 in., in an incredibly short time, and does it so regularly that the paring comes off in one long stripe. It is said that by this little machine, the movements of which are very beautiful, though all the wheel-work is cast-iron, unfiled, one pound of apples can be pared during the time that a nimble-handed person can pare half-a-pound with the knife in the usual way, and much better done. It also takes out the core after the apple is pared.—The Secretary noticed that he had seen these machines lately in the shops for sale, under an English patent.—Thanks voted to Mr. Alexander.

7. The President then laid before the Society several specimens of coloured compressed vegetable fibre resembling papier mâché, made by Mr. R. Endall, Kilmichael, Glen Urquhart. The fibre employed is obtained from some of the most familiar plants, consolidated by pressure and dyed. The specimens shown were in the form of small slabs, varnished on the surface and slightly polished. They resembled in appearance ornamental woods or coloured marbles, and excited much interest. Mr. Endall is in humble circumstances, and in indifferent health. His invention is well worth the notice of manufacturers of papier mâché ornamental furniture, book-boards, &c. Thanks voted to Mr. Endall, and to the President for exhibiting the specimens.

NOTES AND NOVELTIES.

Peculiar Arrangement of a Voltaic Battery.—This battery is designed for medicinal uses. It has been contrived by a constructor at Paris, M. Breton, and is maintained in a constant moisture with chloride of calcium. For one of the poles there is a mixture of copper filings with sawdust, the latter designed to separate the metallic particles,—the filings are mixed with a solution of chloride of calcium. The other pole is a similar mixture in which the copper is replaced by zinc filings. These two preparations placed in a vase, and separated by a porous cell, make a battery which has always the same intensity of action, on account of its constant humidity and the indefinite number of its elements.

The *Calcutta Englishman* states that the Government of India has approved of the proposals of the Director of Public Instruction at Madras, as to the establishment of a college of Civil Engineering, but considers that such training schools as Major Maitland's should be incorporated with the college.

Death of Mr. Bremner, C.E.—We have to record the demise of Mr. James Bremner, C.E., of Wick, N.B., whose name will be familiar to many of our readers in connexion with the recovery of the Great Britain when stranded in Dundrum Bay. Mr. Bremner, besides building ships, had particularly directed his attention to the recovery of stranded vessels, and we believe he had been successful in recovering upwards of 200. Mr. Bremner, who was much respected, died suddenly on the 13th ult.

New Electric Telegraph.—We witnessed, on Saturday, June 28, the operation of a new modification of the electric telegraph, which promises to extend the advantages of that machine in a remarkable manner. At present the number of messages, simultaneously transmitted by the electric telegraph, is limited to the number of wires. If there is only a single wire, only one message can be sent at a time; and, in the event of there being several applicants, the last comer may have to wait so long for his turn, that part of the advantage derived from the speedy transmission of the message may be lost. The experiments that were made in our presence fully established the powers of the machine. Two distinct messages were sent by the same wire, and were read off in an incredibly short space of time. Mr. Duncker has lately tried the invention on a Prussian Government line, and has been eminently successful. He also tried it on a subterraneous line of 160 miles in England, on which occasion the results were satisfactory. It is one advantage of the invention that it is applicable to the existing arrangement of electric telegraphs. It is calculated that the adoption of this invention would enable the directors of the Electric Telegraph Companies to transmit messages at one-fourth of the usual rates, and with more chance of despatch.—*Daily News.*

Australian Mails.—The new Australian mail contract has been granted for five years to a body to be called the European and Australian Steam Company, with a subsidy of £185,000 per annum. The service is to be an independent one from Liverpool or Southampton to Alexandria (calling at Malta), and Suez to Point de Galle and Melbourne, terminating at Sydney. The *maximum* time allowed will be thirty-nine days outwards from Suez, and thirty-five days homeward from Melbourne, fourteen days additional being allowed to and from Suez to this country. Screw steamers are to be employed between Suez and Australia, of 2,200 or 2,500 tons, with 500 to 530 H.P. Between Alexandria and this country they are to be of not less than 1,600 tons. It will take a fleet of seven or eight steamers to convey the Australian mails between Southampton and Melbourne, the distance *viâ* Galle being 11,100 miles. The price to be paid for the conveyance of the mails amounts to nearly 14s. per mile. It will take three steamers to convey the Australian mails between Southampton and Alexandria.

The Crystal Palace Water-Towers.—The water-towers at the Crystal Palace are among the most interesting engineering works of the present day. Some idea of their strength and magnitude may be formed from the fact that each have to support, at a height of nearly 300 ft. above the ground, a body of water of not less than 2,000 tons weight. The towers are polygonal in their construction, and are 46 ft. in diameter from centre to centre of the columns. They are constructed of a series of cast-iron columns and girders; and the whole of the height is divided into tiers or galleries, reached by a winding staircase. The total height of the towers, from the first floor or tier to the top of the chimney-cap, is 279 ft., being 77 ft. more than the entire height of the monument of the Fire of London, 107 ft. higher than the Nelson Column, in Trafalgar Square; and 155 ft. above that of the Duke of York, in Carlton Place. The tank on each tower supplies but one jet of water to the lower series of fountains. The pressure on the mouth of this jet to the square inch is about 262 lbs., and the water rises to a height of 280 ft. When the tank of the water-tower is full, the total weight resting on the foundation of the tower is—water in tank, 2,000 tons; wrought-iron in tower, 240 tons; cast-iron in tower, 638 tons; glass, timber, lead, &c., 200 tons;—total weight of each tower, 3,078 tons. From the base of these towers iron pipes are laid conducting the water to all the fountains of the upper and lower series. For this purpose upwards of ten miles of iron pipes are required. Through the smallest of these pipes a person could easily crawl; the largest would accommodate several. All form a gigantic network, spreading in every direction under the grounds round the Palace. A sum of money as large, we believe, as that expended on the whole of the Crystal Palace and its internal decorations and works of art, has been expended in completing these works. The magnitude of the undertaking may be conceived from the circumstance that when all the fountains are in full operation there are no less than 11,788 jets playing at once, through which 120,000 gallons of water pass per minute.

New Companies.—The prospectuses have just been issued of three new undertakings:—The Thames Steam Tug and Lighterage Company, with a capital of £200,000; the Indian Mercantile Agency, with a capital of £1,000,000; and the Société Parisienne for supplying English coals to Paris, and the Maritime Conveyance of Goods, with a capital of £800,000. The object of the Thames Steam Tug and Lighterage Company is to improve that portion of the goods traffic on the river which, notwithstanding its growth during the last thirty years, is still conducted without the aid of steam, and left dependent upon the tides. Light-draught iron-steamers are to be constructed for the rapid conveyance of suitable cargoes, and also tug-boats for the towage of barges and crafts. The Société Parisienne seems to be supported by northern coalowners. Its object is to take advantage of the modifications recently introduced by the French Government in respect to the importation of coal by establishing a fleet of screw steamers adapted to the navigation of the Seine, which will proceed from the coal ports of England direct to Paris. The fleet is to consist of twenty vessels, to carry 800 tons each; and it is assumed that, in addition to the profits of their outward freight, a considerable revenue will be derived from return cargoes.

NOTICES TO CORRESPONDENTS.

Reviews and Notices of Books.—Our library has collected during the month a large number of books for notice. We have also a few notices of Books and Reviews which we have not yet been able to find space for. We hope in our next to bring up arrears.

Public Works in India.—In our next, I. C. R., R. R. N., and P. Also in our next, H. B. We shall be glad to hear from you.

R. N. (*Douglas*).—The plan sent shall receive our best consideration, and the question of pumping machinery and motive power dealt with as fully as possible, but through the post.

Van Schloss.—1st. Yes, in Rhenish Prussia. 2nd. There are several Englishmen, with Californian experience, at work gold-mining in the Manillas; but they are engaged by Spanish capitalists. Write to Mr. Evan Hopkins, *Civil and Mining Engineer*, Brompton.

Thomas Meriton.—We have been in expectation of receiving the promised communication from you.

D. Vanden Bosch (*Heltevvetshus.*)—Your letter, and the accompanying plan and description of your invention, were duly received, but too late for insertion in the present Number.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 11th June, 1856.

1386. J. H. Johnson, 47, Lincoln's-inn-flds.—Safety paper.

Dated 20th June, 1856.

1454. A. Sands, Manchester—Signalling and saving life and property at sea.

Dated 24th June, 1856.

1482. J. Harrison, Blackburn, and C. Gelderd, Lowmoor, Clitheroe—Looms for weaving.

Dated 26th June, 1856.

1504. D. White, 3, Winchester-pl., Clerkenwell—Apparatus for the more perfect combustion of gases.

Dated 1st July, 1856.

1540. J. A. Longridge, 17, Fludyer-st., Westminster—Application of mechanical power to ploughing, &c.
1542. J. L. Davies, jun., and J. Broadbent, Manchester—Umbrellas and parasols.
1544. A. V. Newton, 66, Chancery-la.—Door lock.
1546. G. E. Dering, Lockleys, Herts—Galvanic batteries.
1548. M. H. Loam, Nottingham—Meters for water.

Dated 2nd July, 1856.

1550. J. H. Van Hengel, 531³, Chaussée de Malines, Antwerp—Raising and lowering bodies in mines.
1552. J. Fleming, jun., Newlands-fields, Renfrew—Bleaching, washing, cleansing, and preparing textile fabrics.
1554. E. Green, Birmingham—Buttons.
1556. A. Nourisson, 10, Rue des Petites Ecuries, Paris—Drying and burning bricks.
1558. J. Williamson and J. C. Stevenson, South Shields—Evaporating saline solutions.
1560. W. H. Burnett, Margaret-st., London—In electric telegraphs.
1562. A. V. Newton, 66, Chancery-la.—Machinery for rope or cordage.

Dated 3rd July, 1856.

1563. J. Pendlebury, Crumpsall, Lancashire—Bleaching or cleansing textile fabrics.
1564. J. Ewing, Cirencester — Portable receptacle for urine, &c.
1565. J. C. H. Peirce, Upper North-pl., Gray's-inn-rd.—Glass chandeliers, lustres, &c.
1566. D. Curwood, Grocers' Hall-ct.—Horse rakes.
1567. J. Brown, 71, Leadenhall-st.—Hats and caps.

Dated 4th July, 1856.

1568. H. Greaves, Oldham—Looms.
1569. E. G. Bradford, Torquay—Rudder.
1570. T. Chandler, 58, Paradise-st., Rotherhithe — Lever cask stand.
1572. R. L. Howard, 85, Whitecross-st., London—Valves for regulating the flow of fluids.
1573. J. H. Johnson, 47, Lincoln's-inn-flds.—Machinery for cleaning and carding cotton. (A communication.)
1574. L. Cornides, 4, Trafalgar-sq., Charing-cross—Cementing and uniting together surfaces of glass, or surfaces of glass metal.

Dated 5th July, 1856.

1575. E. Travis, Oldham, and J. L. Casartelli, Manchester—Steam-engines.
1576. J. Foss, Manchester — Machinery for cutting and sawing.
1577. J. Adshead, Manchester—Substitute for plastering, painting, papering, whitewashing, and colouring.
1578. J. Lewtas and J. Humphreys, Manchester—Apparatus for holding and releasing cords, chains, bands, or bars.
1579. J. A. Manning, Inner Temple, London—Manufacture of manure.
1580. P. C. J. L. de Combettes, Lyon, France—Steam-engine.
1581. J. M. Letestu, Paris—Extracting liquids and solid or pasty matters.
1582. T. Smith, Bredfield, Suffolk—Horse rakes.
1583. L. Blackstone, Lawrence-la., London — Corks and bungs.

Dated 7th July, 1856.

1584. F. J. Pilliner, Hatfield-st., Stamford-st., Blackfriars-rd.—Clasps for waistbands.
1585. R. Millward, Patricroft, Manchester—Screw key or gauge.
1586. R. Shaw, Portlaw, Waterford, Ireland — Obtaining pressure applicable to machinery for preparing and spinning cotton.
1591. G. Sampson, Bradford—Finishing fabrics.
1592. W. C. Cambridge, Bristol—Press wheel rollers and clod crushers.
1593. H. Smith, Brierley Hill Iron Works, Dudley—Harrows.
1594. J. Horsfall, Birmingham—Wire rope.
1595. W. Laing, Denny, Stirling, N.B. — Stretching or breadthening woven fabrics.
1596. P. C. J. L. de Combettes, Lyon, France—Rotary steam-engines.
1597. E. C. Healey, Sidmouth-lodge, Old Brompton, and E. E. Allen, 376 Strand—Preparing for use veneers, paper, &c.
1598. H. B. Condy, Battersea—Purifying acetic acid and other solutions, also in disinfecting rooms and other places, and in preserving wood.
1599. J. H. Noone, 1, Peter-st., Sun-st., Bishopsgate—Retarding and stopping carriages on railways.

Dated 8th July, 1856.

1600. Rev. G. B. Watkins, Godmanchester—Obtaining infusions or extracts from various substances.
1601. W. Youtman, Southampton—Valves and plugs.
1602. J. H. G. Wells, 45, Essex-street, Strand—Pistons for steam engines and pumps.
1603. J. H. G. Wells, 45, Essex-st., Strand—Governors or regulators.
1604. F. W. Hoffman, New York, U.S.—Breech loading fire-arms.
1605. H. Page, Whitechapel-rd., Middlesex—Decorating glass.
1606. J. F. Belleville, Paris—Generating and ap plyg steam.
1607. R. Martineau and B. Smith, Birmingham—Taps for drawing off liquids.
1608. A. V. Newton, 66, Chancery la.—Repeating fire-arms. (A communication.)
1609. A. V. Newton, 66, Chancery-la.—Fountain pen.
1610. A. Herts, 22, Bunhill-row, Finsbury—Sheet metal bending and tubing machine.
1611. A. Gray, Glasgow, N.B., and J. Rawson, Bury, Lancashire—Apparatus for lubricating.
1612. L. Bayer, Soho, London—Stuffing in place of hair or other substances.
1613. S. Short, New London, U.S.—Horse shoes.
1614. H. Pigott, Glasgow—Hats.
1615. D. Fisher, 12, Ranelagh-rd., Thames-bank—A composition for coating metal, plates, or wheels, used for grinding.

Dated 9th July, 1856.

1616. W. B. Adams, 1, Adam-st., Adelphi—Railway wheels, axles, and axle-boxes.

1617. A. Krupp, Essen, Prussia—Permanent way of railways.
1618. R. Bodmer, 2, Thavies-inn, Holborn—Self-acting apparatus for spinning cotton, &c.
1619. G. Darlington, Kingston, Jamaica, and J. Darlington, 36, Cannon-st., London—Manufacture of zinc or spelter.
1620. W. Holroyd and W. Noble, Queen's Head, near Halifax—Machinery for cutting wood and stone.
1621. D. W. Hayden, Glasgow—Fastenings for window shutters.
1622. T. Jerome, 125, Gt. Hampton-st., Birmingham—Buttons and loops.
1623. A. W. Williamson, London University, Gower-st.—Obtaining the rosin and sugar of scammony.
1624. W. Robertson, Manchester—Machines for spinning and doubling cotton.
1625. E. Wilson, 12, Eccles-st., Dublin—Pistons for steam-engines driven by steam.
1626. M. Defries, Houndsditch—Moderator and other lamps.
1627. R. D. Kay, Accrington—Machinery for pressing, straining, sifting, or refining colours and thickened mordaunts.
1628. R. T. Eadon, Sheffield—Band saws and bands or hoops of metal.
1629. H. Adcock, City-rd.—Casting iron, &c.

Dated 10th July, 1856.

1630. F. W. Russell, Aldgate, London—Coupling railway carriages.
1631. J. Marsh, Nottingham, and J. Catt, Stepney, Middlesex—Manufacture of textile fabrics.
1632. P. Prince, Derby—Moulds for casting railway chairs, &c.
1633. S. Hardacre, Miles Platting, Lancashire—Compound conical spike and spiral double gridded machine for opening, blowing, scutching, and cleaning cotton, wool, &c.
1634. C. W. Lancaster, New Bond-st.—Apparatus for inking, printing, or stamping surfaces.
1635. J. Fowler, jun., Havering, Essex, and W. Worby, Ipswich—Machinery for ploughing and tilling land by steam.
1636. S. M. Saxby, Rock Ferry, Cheshire—Ascertaining the errors of mariners' compasses.

Dated 11th July, 1856.

1637. R. H. Leadbetter, Glasgow—Preparation of flax.
1638. R. Harrington, Witham, Essex—Umbrellas, &c.
1639. J. Westwood, Lichfield-st., Walsall—Hand and railway lamps.
1640. T. Charlton and W. Turnbull, Brentwood, Essex—Steam generators.
1641. Gen. H. Dembinski, Rue Joubert, 8, Paris—Apparatus giving a self-acting motive-power, produced by weight, elasticity, compressed water, or any gas whatever.
1642. J. B. D. Chevalier and N. P. O'Sullivan, Paris—Obtaining printing surfaces, and printing therefrom.
1643. E. H. G. Monckton, Parthenon Club, Regent-st.—Destroying grubs.
1644. A. N. Wornum, Store-st., Bedford-sq.—Grand pianofortes.

Dated 12th July, 1856.

1645. B. F. Ortet, 39, Rue de l'Echiquier, Paris—New metallic composition for surfaces.
1646. T. M. Hartwell, J. W. Gladwin, and H. Gladwin, Manchester—Stretching woven fabrics.
1647. W. B. Adams, 1, Adam-st., Adelphi—Permanent way of railways.
1648. J. Pope, Wincheap-st., Canterbury—Application of steam-power to ploughing.
1649. W. Petrie, Woolwich—Porous material for filters.
1650. A. Herts, 22, Bunhill row, Finsbury—Apparatus for holding material during the operation of sewing.
1651. J. Avery, 32, Essex-st., Strand—"Plate-holder" for photographic purposes.
1652. J. Rowley, Camberwell, Surrey—Substitute for leather.

Dated 14th July, 1856.

1653. P. B. Rassant, Paris—Transforming an alternate into a continuous circular motion.
1654. C. Burrell, St. Nicholas Works, Thetford—Portable apparatus suitable for distilling from beet-root.
1655. R. Dendy, Hornchurch, Essex—Horse-rakes.
1656. A. V. Newton, 66, Chancery-la.—Securing the plastering of ceilings.
1657. W. Williams, Dale, Pembrokeshire—Cutting and dressing stone by machinery.

Dated 15th July, 1856.

1659. W. Edwards, Salford—Lathes and tools for boring, shaping, cutting, and screwing metals.
1660. W. Clibran and J. Clibran, Manchester—Regulating and measuring gas.
1661. W. Watt, Belfast—Manufacture of starch.
1662. E. Leigh, Manchester—Generating steam for obtaining motive power.
1663. J. Knowelden, 3, South-st., Southwark-sq., Southwark—Preventing steam-boiler explosions.
1665. J. H. Johnson, 47, Lincoln's-inn-fields—Apparatus for consuming smoke to be applied to lamps and gas-burners.
1666. C. B. Blyth and W. P. Butchart, Dundee—Weaving.
1667. G. T. Bousfield, Sussex-pl., Loughborough-rd., Surrey—Pumps.

Dated 16th July, 1856.

1669. John Bourne, 9, Billiter-st., City—Feathering paddle-wheels.
1671. J. Ford, Preston, and P. Knowles, Bolton-le-Moors—Cleaning and preparing cotton.
1673. R. Morgan, Acton, Middlesex—A pocket-case for containing address cards, stamps, &c.
1677. J. H. Johnson, 47, Lincoln's-inn-fields—Circular looms.
1679. A. F. Gurlt, 40, Newington-pl., Kennington—Manufacture of iron and steel.

Dated 17th July, 1856.

1683. J. Cartwright, Shrewsbury—Chain harrows.

Dated 18th July, 1856.

1691. E. Mehrel, Paris—Hand planes.

Dated 21st July, 1856.

1715. E. Leak, Longton, Staffordshire—A thimble pillar, with points and branches, to be used in placing "glost" china and earthenware in ovens and kilns, when firing, burning, or baking such ware, in lieu of the cockspurs and stilts now in use for that purpose.
1717. F. Barbour, Manchester—Pen-holders.
1719. J. Clark, Newton Heath, Manchester—Manufacture of waterproof fabrics.
1721. J. Gedge, 4, Wellington-st. South, Strand—Obtaining and applying motive power.
1723. M. Vergnes, New York, U.S.—Electro-galvanic machines for producing motion by galvanic electricity.
1725. J. E. Hodges, Leicester—Machinery for the manufacture of looped fabrics.
1727. J. Bing, Hamburgh—Sauce-boat.

Dated 22nd July, 1856.

1729. C. Amet, Tavistock-st.—Improved means of distending articles of dress, and preserving the form or shape thereof. (A communication.)
1731. E. Weisskopf, Pesth, Hungary—Artificial combustible.
1733. S. J. A. Burg, 1, Serle-st., Lincoln's-inn—Preventing the explosion of steam boilers.
1735. S. Butcher, Bristol—Kitchen ranges.
1737. J. Clark, Newton Heath, Manchester—Beds, mattresses, &c.

Dated 23rd July, 1856.

1739. G. North, 9, Ashburnham-rd. Greenwich—Spring catch for the security of jewellery.
1740. S. F. Berthiez, 6, Red Lion-st., Borough—Engines to be worked by a new elastic fluid in substitution of steam generated out of water.
1741. F. Potts, Birmingham—Tags for stay laces.
1743. W. Webster, 22, Bunhill-row—Steam and fire regulator.
1744. W. Webster, 22, Bunhill-row—Pumps.
1745. R. B. Ellison, 9, Brook-st., London-rd., Carlisle—Electric telegrapb apparatus.
1747. A. Bain, Brompton, and B. J. Heywood, Leicester-sq.—Supplying and drawing off liquids.
1749. J. Derbyshire, Longton Potteries, Staffordshire—Cocks, taps, and valves.
1751. C. L. Detouche and J. J. E. R. Houdin, jun., Paris—Application of clocks or timekeepers, actuated by electricity, to street and other lamps.

Dated 24th July, 1856.

1753. H. C. F. M. Petschler, Manchester—Obtaining and applying motive power.
1754. J. Ashman, Swansea—Artificial limbs.
1755. C. Burton, 162, Regent-st.—Warming houses, &c.
1756. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Driving straps or bands.
1757. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Flexible hose and tubes.
1758. G. Collier and J. Crossley, Halifax, and J. W. Crossley, Brighouse, Yorkshire—Finishing and stretching woven fabrics.
1759. G. A. Copeland, Constantine, near Falmouth, Cornwall—Safety blasting cartridge, for the use of miners.
1760. C. T. Judkins, 98, Fleet-st.—Gas regulator.
1761. J. Mather and W. Forshaw, Bolton-le-Moors—Pickers for looms.
1762. R. A. Brooman, 166, Fleet-st.—Grindstones. (A communication.)
1763. C. F. Cattaert, Paris—Stoppering of inkstands, bottles, pots, jars, &c.

Dated 25th July, 1856.

1764. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Vulcanized india-rubber thread.
1766. E. Lord, T. Lord, A. Lord, and W. Lord, Todmorden—Machinery for opening, blowing, scutching, and preparing cotton.
1767. W. Wood, Monkhill-house, Pontefract—Machinery for weaving pile fabrics.
1768. T. Byford, Carlton-vils., 34, Edgware-rd.—Horses' bits.
1769. R. Stewart, Glasgow—Cutting stone and other substances.
1770. T. Wrigley, Bury—Machinery for cleaning "cotton waste," or other materials used in the manufacture of paper.
1771. J. H. Johnson, 47, Lincoln's-inn-fields—Scutching machines.
1772. S. Jay and G. Smith, 246, Regent-st.—Stuffing or padding couches, &c.
1773. E. Howes, Liverpool—Anchor.
1774. W. L. Anderson, Norwood, Surrey—Propellers.
1775. I. Baggs, Manchester st., Argyle-sq.—Apparatus for lighting, signalling, and telegraphing by electricity.
1776. J. Denis, Queenhithe—Cutting or perforating steel and other metals.

Dated 26th July, 1856.

1777. J. Platt, Audlem—Door-knockers.
1778. C. Hodges, Manchester—Apparatus for unwinding silk, thread, or yarn from the hank.
1779. R. C. Pauling, Great George-st., Westminster—Giving increased buoyancy to ships and vessels, in raising sunken vessels, in keeping structures watertight, and in propelling vessels.
1780. J. Dickinson, Liverpool—Anchors.
1781. S. Yeadon, Idle, near Bradford, and G. Chapman, Stockport—Construction of reeds for weaving.
1782. G. C. Cooke, George-yd., Lombard-st.—Stereoscopes.
1783. H. Remington, Camberwell—Gas heating and cooking apparatus.

Dated 28th July, 1856.

1784. J. Coplin, Falmouth—Ship windlasses.
1785. G. Ritchie, 3, Ponsonby-st., Pimlico—Boots and shoes from materials not hitherto used.
1786. H. Robinson, Settle, Yorkshire—Mechanism for the conveyance or transport of loads.
1787. E. Eaborn and M. Robinson, Clement-st., Birmingham—Machinery for confectionery purposes.
1788. W. E. Newton, 66, Chancery-la.—Instrument for for taking altitudes.
1789. W. E. Newton, 66, Chancery-la.—Steam-engine governors.

Dated 29th July, 1856.

1790. P. J. Livsey, Manchester—Mechanism for rotating and retaining the rollers of window blinds.
1791. W. Griffin and Elizabeth Duley, Northampton—Studs and buttons.
1793. J. Knowles, Derby, and W. Buxton, Birmingham—Tuyères.
1794. W. E. Newton, 66, Chancery-la.—Generating illuminating gas.
1795. H. R. Bowers, Penbedw, near Ruabon, Denbighshire—Machinery for grinding, crushing, or pulverising clay, &c.
1796. G. Davies, 1, Serle-st., Lincoln's-inn—Portable apparatus for copying letters.
1797. A. W. Anderson, Trinidad—Improvements in refined sugar.

Dated 30th July, 1856.

1798. F. Caron, Great Titchfield-st.—Fastening the handles of door locks and door finger plates.
1799. R. W. Siever, Upper Holloway—Preserving wood from decay.
1800. H. Evette, Lizieux, France—Looms for weaving.
1801. J. Denis, Queenhithe—Gelatinous soap.
1803. Lieut. F. C. Simons, Kensington—Rifling the barrels of fire-arms.

Dated 31st July, 1856.

1804. J. Hopwood, Bolton-le-Moors, Lancaster—Machinery for measuring and folding fabrics.
1805. G. Holcroft, Manchester, and P. Johnson, Wigan—Manufacture of cement.
1806. Lieut. J. J. Kerr, R.N., Twickenham—Cartridges.
1807. C. J. B. Torassa, Genoa—Obtaining motive power by explosive gases.
1808. J. Evans, Castleton, Pembroke—A progressive lever.
1809. W. E. Newton, 66, Chancery-la.—New musical instrument, to be played by the agency of steam or highly compressed air.
1810. W. E. Newton, 66, Chancery-la.—Obtaining aluminum.
1811. R. A. Brooman, 166, Fleet-st.—Carriages and waggons.
1812. R. A. Brooman, 166, Fleet-st.—Augur or boring tool. (A communication.)
1813. P. M. J. Chamblant, 36, Rue de Lanery, Paris—Manufacture of glass.
1814. W. Coltman, Leicester—Knitting machinery.
1815. T. Wicksteed, Coleman-st.—Separating sewage matters from water.
1816. T. Routledge, 17, Gracechurch-st.—Manufacture of half stuff and paper.

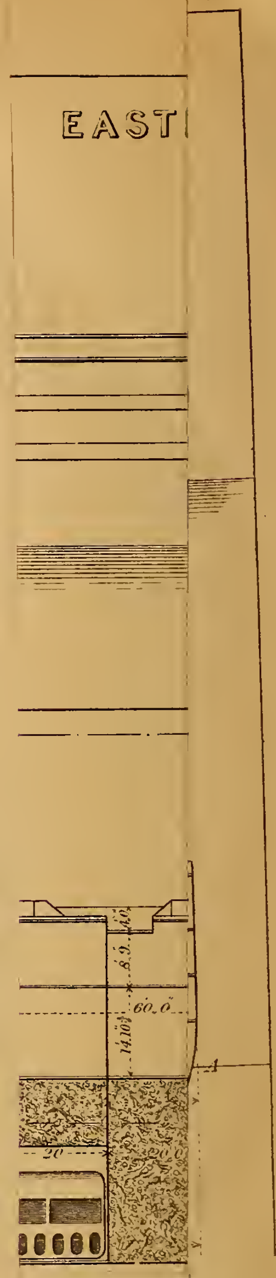
INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

1688. F. R. Howell, Lebanon, Ohio, U.S.—Machinery for making corks.—18th July, 1856.
1826. W. F. Shaw, Massachusetts, U.S.—Gas burner—1st August, 1856.
1854. J. Y. Borland, Manchester—Preparing and spinning fibrous materials—6th August, 1856.
1868. J. Woodman, Manchester—Telegraph insulator—8th August, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.

July 11, 3857. Waterlow and Sons, London Wall, "Improved Date Indicator."
„ 14, 3858. A. G. Baylis and Co., Redditch, "Needle Case."
„ 15, 3859. J. and M. Robson, North Shields, "Water-closet Cistern for Constant Supply."
„ 17, 3860. H. Whittell, Leamington, "Nouvel Albert Boot."
„ 24, 3861. W. P. Marshall and J. Ross, Birmingham, "Fastening for Bottom or Railway Hopper Waggon."
„ 24, 3862. G. Neall, Northampton, "Gas Stove."
„ 29, 3863. W. Devon and G. Saunders, Stratford, Essex, "Wasteless Water-Valve and Ball-Tap Apparatus."
„ 29, 3864. R. Waygood, Newington-causeway, "Water-tight Spindle Bearing."
„ 31, 3865. C. W. Lancaster, New Bond-st., "United Service Square."
Aug. 2, 3866. W. Chamberlain, Dodbrook, "The Compound Spade Plough."
„ 4, 3867. W. Middlemore, Birmingham, "Hobble for Cattle."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THE ARTIZAN.

No. CLXV.—Vol. XIV.—OCTOBER 1st, 1856.

THE EASTERN STEAM NAVIGATION COMPANY'S GREAT SHIP, WITH A SUGGESTION FOR ITS FIRST EMPLOYMENT.

In The Artizan for June last we gave the first of the series of Plates illustrative of the great ship and her machinery; the Plate we then published was a transverse section of the after part of the hull, exhibiting the peculiarity of the construction, and showing accurately to a scale of 1-8th in. to 1 ft. a side-view of the engines and machinery for driving the screw-propeller. We also gave a general description of the ship and the engines and machinery intended to be fitted on board; that description, which is accurate in every particular, has excited great interest amongst our readers and the public, aud we have been inundated with inquirics, not only from our country subscribers and readers, but from all parts of the world.

In our July Number we gave the second Plate, being a plan of the screw engines, machinery, and one set of boilers, contained in the after compartments allotted to the screw-propelling machinery.

We also gave, in continuation of our previous remarks, additional particulars respecting the vessel and machinery; and, as we then stated, that in consequence of the uncertainty which prevailed as to many of the details, we must defer giving any description of the style of equipment, rig, or the fitting up of the vessel; and we regret that we are still unable to do so.

Since the month of July, when we were prepared to give in our August Number the longitudinal views of the ship, and which views would exhibit correctly the construction of the ship, the disposition of the decks, bulkheads, cargo spaces, saloons, &c., and also the accurate positions of the screw and paddle-engines, the boilers, paddles, screw, screw-shaft, and other material points of interest, we found that various important variations were proposed by Mr. Brunel, and which have since been made, thus rendering the very costly plate and the engravings useless for the purpose of publishing in The Artizan—priding ourselves, as we do, on the precise, accurate, and thoroughly-reliable character of our regular "Artizan Plates," which gives to them the high value in which they are held by practical men as works of reference, for which purpose they are so much esteemed.

We therefore determined to abandon the Plate, notwithstauding the vast expense incurred by us in producing it; and after making drawings of the alterations which had been determined upon by Mr. Brunel, and which were in course of execution, we have engraved an entirely new Plate, with the numerous alterations and every particular correctly laid down, with the kind assistance and under the able direction of Mr. Brunel's talented representative at the Millwall Works.

In presenting our subscribers with the accompanyiug Plate, No. lxxxv., being the third plate of the series, we do so with the satisfaction of knowing that the details given *are accurate in every particular*, and that we have spared neither time nor money to give to our subscribers, at the earliest opportunity, the accompanying Plate of this interesting work of naval construction, in accordance with our promise; and we feel that in doing so we are but doing justice to the talents of the designer of the great ship, and to the efforts of those engaged in connection with the various departments of the work, as likewise to our subscribers and ourselves.

The dimensions of every part are figured in the three views given in the accompanying Plate (No. lxxxv.), and by reference to the textual descriptions already published in our Numbers for June, July, and August last, the details will be perfectly understood.

We have in preparation several other Plates, in continuation of our illustrations of the great ship and her machinery and fittings, and hope to present to our subscribers another of these very interesting Plates with our next Number.

It may be observed that amongst the alterations made after our first Plate (for which the accompanying No. lxxxv. is the substitute) was finished, Mr. Brunel determined to continue the double skin right forward to the bow and entirely aft, instead of terminating the double arrangement of plating and cellular structure in the fore part, at the bulk-head forward of the coal bunkers and of the foremost set of boilers, and in the after part with the after bulkhead of the screw-engine room; the centres of the paddle engines, and also of the screw engines and machinery were varied, the paddle engines being shifted further aft; the arrangement of the decks forward and aft was varied. The design and the position of the paddle-boxes were altered, and in several other respects alterations were made, not certainly very material for a popular illustration of the great ship and her machinery, but nevertheless of vital importance for The Artizan.

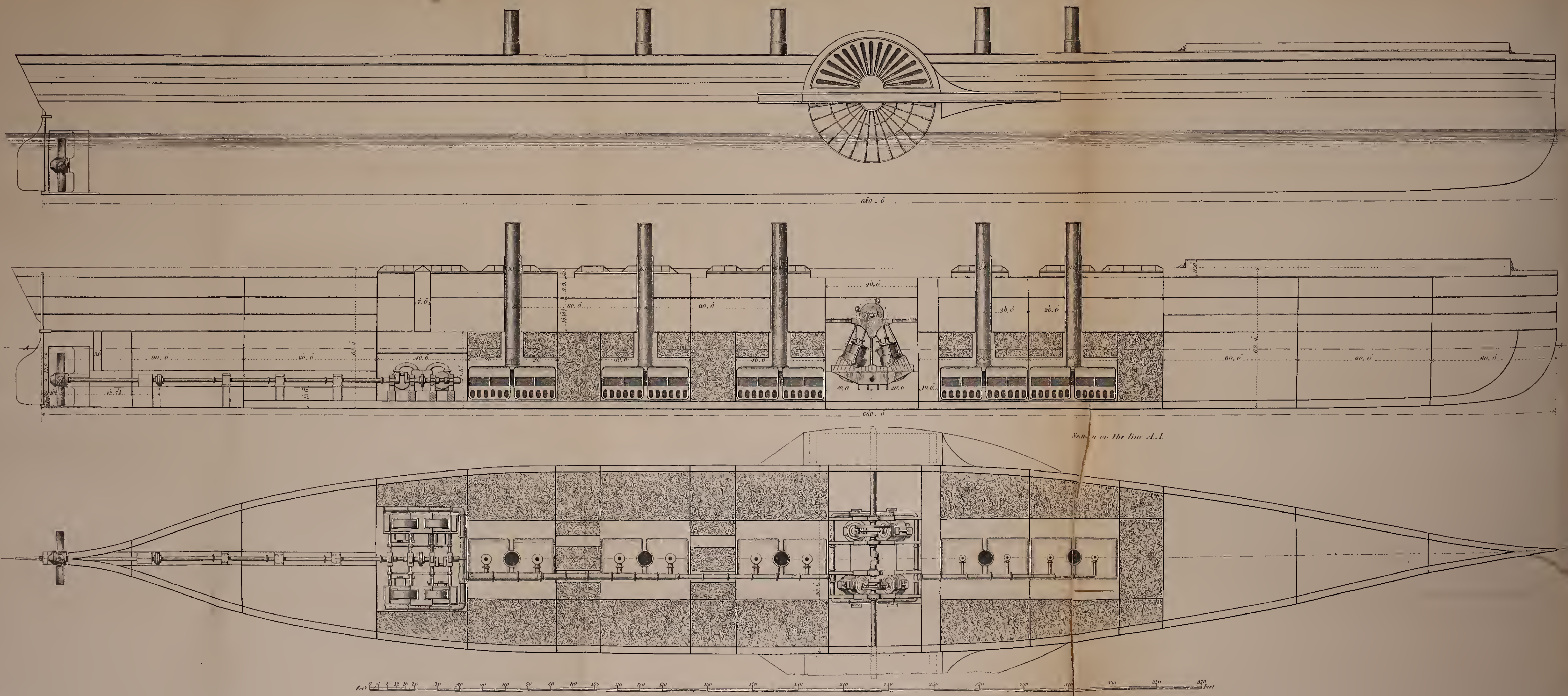
We have a suggestiou which has occurred to us, and which we desire to make to the proprietors of the great ship, and we believe it will be found to be worthy of their serious consideration.

The vast importance of the electric telegraph, particularly the submarine telegraph, is now so generally recognised, and the advantage of our being in almost instantaneous communication with distant parts of the world, is, in a commercial as well as in a political point of view, of the gravest and chiefest importance. Of the practicability of finding a short line across the Atlantic with a suitable bed for a submarine telegraph to rest securely upon, at a moderate depth, we have now pretty satisfactory evidence, from the recent soundings made by order of the United States' Government, between Ireland and Newfoundland.

Now, the possibility of laying down successfully lengths of 200 to 300 miles of heavy telegraph cable has also been demonstrated; notwithstanding the want of success in several instances, from what we know to have been gross ignorance and mis-management on the part of those concerned, in some of the cases referred to; but to deal with so great a length of telegraph cable as 3,000 miles in one piece, even though it should be but a single conducting wire, coated with insulated material and overlaid or protected with a covering of iron wires (strand-like), is a matter of no small difficulty.

The difficulty experienced by the Mediterranean Electric Telegraph Company, in obtaining a ship with sufficient capacity, and otherwise suitable for stowing the length of cable intended to join the Island of

EASTERN STEAM NAVIGATION COMPANY'S GREAT SHIP.



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G.H. Smith Sc.

Sardinia with Cape Boua, on the coast of Africa, was considerable; and although the diameter of the Mediterranean cable was nearly *twice* that of tbe proposed Atlantic cable, the length of tbe former is only about *one-fifteenth* of wbat will be required to cross the Atlantic by the shortest practicable route.

To find a vessel capable of holding the whole of the Atlantic cable is a matter of the first importance for the progress and success of the undertaking.

Now, our suggestion is, that tbe first employment of the great ship—after she bas been launched into that element in whicb, we believe, she is destined to "figure extensively," and to "cut a great swell"—should be to take on board the entire cable, aud thus aid the projectors of anotber great undertaking of world-wide importance, iu carrying out their enterprise.

Tbe great sbip is in every way suited for this undertaking, and it would be an immediate and profitable employment, in which her sea-going capabilities aud the working of her machinery might be practically tested, before incurring the great expense of fitting up her internal arrangements for the convenience and comfort necessary for tbe purpose of passenger accommodation. Here, also, would be a source of obtaining the means of finishiug the vessel according to the original design, in a suitable manner, resulting from tbe experience gained wbilst so employed, and that, too, without calling for tbe necessary capital from the shareholders.

Our limited space this mouth prevents our further extending our remarks upon the present occasion, but we propose to return to the subject again in our next.

THE THAMES IRON SHIP-BUILDING, FORGE, AND FOUNDRY COMPANY.

IRON SHIP-BUILDING ON THE THAMES.

We are glad to find that the magnificent works lately belonging to Messrs. C. J. Mare and Co., Orchard Yard, Blackwall, are to be carried on, and witb the advantage of increased spirit and enterprise, and a large capital, by au Association formed under the Limited Liability Act, 1856, consisting of Mr. Rolt, M.P., Messrs. Maudslay, and members of otber London engineering firms, and a few practical, scientific, and commercial gentlemen. The capital is made up of shares each of the value of £1,000.

To have permitted the Orchard Works to be closed, and the excellent and powerful tools and machinery, which were collected at a vast expense, to be sold off in lots and dispersed over the country, would have been a very blind act on the part of tbe great London engineering firms, to whom the existence of such an establishment (particularly the forge) had become a matter of the greatest conveuience, and almost of vital importauce. Since the establishment of the Orchard Yard Works, by Ditchburu and Mare, the progress of iron ship-building has made wonderful strides, and the Tbames has sent fortb the largest and finest of the iron steamships afloat. But since the eulargement of the ship-building yard, by C. J. Mare, and the erection of the largest forge and mill in this part of tbe country, with corresponding foundry conveniences, the great engineering firms of London have constantly employed tbe Orcbard Yard Forge in making their largest uses, and forgings of all kinds, which have been executed in an unequalled style of excelleuce, whicb has obtaiued for the works a well-earned reputation.

Now if the largest ship-building yards on the banks of the Thames were closed, and the business transferred to tbe Clyde or the Mersey, it is only reasonable to suppose that many of the orders for engines and machinery would also follow, thus doing tbe Thames engineers serious damage.

We trust that what has already occurred in conuection with these works and their late proprietor, will prove a sufficient warning to those about to embark in what should be (and properly managed will be) a highly profitable business, and thereby prevent a repetition of such a misfortuue. We feel sanguine as to the tborough success of the new Association, under tbe careful and practical management of those associated with the direction of tbe new Company, wbich will, we understand, have tbe title of "Thames Iron Ship-building, Forge, and Foundry Compauy."

PUBLIC WORKS IN INDIA.

The general tenor of the speech lately delivered in Parliament, upon tbe affairs of India, by Mr. Vernon Smith, has, upon tbe whole, given much satisfaction to that large circle of persons who are now interested in the prosperity of that country. Not only does the prosperity of India concern the British public because it is now a part of the empire from the reverses of wbich we must all suffer, and the debts of wbich we must pay; but as India produces most of the foreign articles whicb we consume, and consumes a large part of the commodities we produce, we have in the prosperity and productiveness of that country an assured source of supply for the raw materials we require, and also an assured market for our manufactures. Every one is sensible how precarious are tbe supplies of cotton from America, wbicb, if stopped by war or otber accidents, would produce a cotton famine, the effects of which would be of a most formidable cbaracter; and India is the only country to which we cau look for such supplies of cotton aud other materials necessary for our manufactures as will save us hereafter from these dangers. Tben, again, it is to the development of the resources of India that we must chiefly look for the extinction of tbe slave trade. It is conclusively ascertained that cotton and other slave-grown productions can be furnished by India at a cheaper rate by free labour than is possible in countries where slave-labour is employed; and slave-labour will cease to be used when it ceases to be profitable.

Before, however, the resources of India can be sufficiently developed to yield these advantages in auy eminent degree, tbe wide application of two main features of improvement is indispensable. The one of these is the distribution of water over the land by meaus of suitable trenches or canals, so as to accomplish effectually the irrigation of the land; tbe other is such a connexion of these irrigating cbannels with the rivers as to enable the produce of the soil to be conveyed to the sea by water carriage at a small expeuse. In all tropical countries there is no fertility without water, and in India it is found that effectual irrigation will increase the productiou of the land four-fold. Over a large part of India, however, the water employed for purposes of irrigation is raised from wells by a very costly and laborious process, whereas it has been found that, by the construction of suitable irrigation works, the water may be distributed over the land at one-sixtieth part of the expense that it costs if raised from wells. The only mode of conveying rough articles of produce from the interior to the coast, that is sufficiently cheap to euable them to be carried through any considerable distauce, is by water. Railways of cheap construction, though useful in some situations to transmit commodities through moderate distances, are wholly useless when the problem is how to trausmit such articles as cotton, grain, sugar, and hemp to the sea-coast a thousand miles distant. If all our imports from India had to be brought by a railway overland, what would be their amount? and inasmuch as the conveyance by sea is much cheaper than any possible conveyance by laud, so in like manner it is only by virtually carryiug the sea into the heart of India by providing suitable means of iuternal water communication, that the necessary cheapuess of transport for the great bulk of the productions of the iuterior of India can be afforded.

The advantageous results produced by the establishment of suitable works of irrigation in India are neither uncertain nor untested. Many important works of irrigation which had been constructed by the ancient sovereigus of India have fallen into decay, but recently the Government has constructed works of irrigation in various parts of India, the benefits of which to the people, as well as the profits to the Government, have been very remarkable. By official returns it appears that the return to the Government of the capital expeuded on the irrigation works of the

Madras Presidency, taking bad and good together, on the average of the several years since the works were commenced, has been 69½ per cent., and the amount of this return is increasing every year. Of course the latest return is much more than 69½ per cent., as the return was not so large while the works were still unfinished. In every case in which irrigation works have been established in India, a very large profit has been returned on the capital invested in them, while the benefits they have conferred upon the people, in the localities in which the works are placed, have been still more momentous. While torture has been resorted to in other parts of India to enforce the payment of the land-tax from the wretched natives, in the districts blessed by the benefits of irrigation torture has been unknown, the people in all cases paying the assessment willingly, because they were able to do so. These districts, indeed, present a marked contrast to other contiguous districts to which the irrigating channels do not extend. In the irrigated districts the people are well fed, well clothed, and are not visited by famine, whereas in the other districts these auspicious results are by no means attained.

With regard to the establishment of cheap means of communication throughout the interior of India, the most feasible means of attaining that end appears to be, by the establishment upon the rivers, of an effectual and comprehensive system of steam navigation. Such a system was proposed to be established in India several years ago by Mr. Bourne, and we gave at that time a drawing of his trains of shallow barges propelled by steam-power, by which the navigation of the rivers of India was proposed to be carried on. Trains of barges of this description are now used upon the rivers of America to an enormous extent; they are also used upon most of the rivers of the Continent, and it is greatly to be lamented that India has remained so long without the benefit of this improvement. This evil, however, is now about to be redressed. Mr. Bourne has established a company to carry into operation his design for navigating the rivers of India, now so carefully matured and so fully investigated during many years, and the following considerations appear to show that the undertaking promises to be as profitable to its supporters as it will be advantageous to India.

The steam navigation at present carried on upon the Ganges, though of a much less efficient and profitable description than could now be employed has, nevertheless, been able (as appears by the Calcutta newspapers) to return a profit for its proprietors during the last year, of 48 per cent. Upon the Godavery river the results have been still more remarkable. The proprietors of some small paddle-vessels upon that river, which are known to be of very imperfect construction, have realised a return during the last half year which is at the rate of 55 per cent. per annum. The railways of India, on the contrary, have yielded almost no return. The "Friend of India," of 18th October, states that the East Indian Railway was at that time opened 121 miles out of Calcutta, at a cost of £10,000 a mile, or £1,210,000 in all;—that the receipts for six months were £25,000, and the expenditure £17,000, leaving £8,000 for dividend, which is at the rate of 1⅓ per cent. per annum upon the capital, and this without including depreciation or wear and tear. The whole receipts of the line at this time did not exceed 4 per cent. per annum upon the capital expended. On the Bombay Railway the results are about as bad.

So much for the comparative profits of railways and steam-navigation in India. The fact is, expensive railways maintaining a high rate of speed, are not suitable for India. Even after they are made, the result shows that they are little used, and they do not appear calculated to satisfy that want of cheap locomotion which is one of the main things required. Even in a rich country like England, expensive railways hardly pay; and the only prospect of enabling them to pay in India, appears to lie in such a development of the internal resources of the country as will enable the population to use the luxuries of life, and among them, the luxury of railway locomotion. The navigation of the rivers, therefore, instead of interfering with the prosperity of the railways, appears to be indispensable to enable them to attain even a moderate measure of prosperity. The greatest part of the produce of the interior of India must either have water conveyance to the coast, or must remain ungrown; and if it be not grown, there will be no fund available to the natives by which they can purchase articles which are not mere necessities of existence, or by which they might hope to become employers of railway locomotion. Whatever enriches the country, will benefit the railways, since opulence must exist before railways of a swift and expensive character can be much employed. The establishment of suitable steam-navigation on the rivers of India, such as Mr. Bourne now proposes to supply, will have the effect of opening up the interior of that country, and will afford a cheap outlet for its productions. The Ganges can be navigated as high up as Gurmucteesir, and the Jumna to within a few miles of Delhi. Here, a canal of no great length, and which would be valuable for irrigation, would join the Jumna and the Sutlej, establish a communication by water between the Indus and the Ganges, and convert India into an island. Of the tributaries of the Ganges and Jumna, the Chumbul may be navigated in all seasons of the year to Kotah, in latitude 25°, and during the rains, to the foot of the Vindhya mountains, on the northern bank of the Nerbudda. The Goomty river may be navigated to Lucknow, and the Gogra and Gunduck through a considerable part of their length. The Godavery river may be navigated during the rains, into the cotton districts of Nagpore, and throughout the year to a considerable distance from the sea. Of the Nerbudda and Tapty, considerable lengths are navigable; and the Indus and its tributaries may be ascended to a range of hills called the Salt Range, a short distance below the Himalaya. By no other conceivable amelioration can so much be done to provide cheap means of internal communication in India as by the navigation of the rivers by steam; and in the proportion of the benefits conferred by the undertaking on the public, will be the benefit to those by whom the undertaking is carried out. An improvement that is much wanted will of course be much used; and if it can be much used at a small expense to its proprietors, it is easy to understand how the profits upon it may be large. Rivers have not to be constructed: there is no capital sunk in them—no wear and tear, and they have not to be maintained at a heavy expense. Steam-vessels, if found unprofitable on one line, can be shifted to another; whereas, a railway once made, is fixed for ever, and any mistake in the line selected can never be repaired.

THE LATE STEAM TRANSPORT SERVICE.

THE SOUTH AMERICAN AND GENERAL STEAM NAVIGATION CO.'S SCREW STEAM-SHIP THE "IMPERATRIX."

We join heartily with our fellow countrymen in giving, ungrudgingly, special honours and a hearty welcome to our heroes of both services—both the soldiers and sailors—as they return to their native land, after fighting our battles, and sustaining, untarnished, the honour of our lands. Those who know, practically, what it is to carry on a war 3,000 miles from these shores, will at once admit that the Transport Service, with which the Mercantile Marine furnished the Executive for the purpose of carrying on the transport of men and stores, will agree with us that great credit is due to the skill and energy which characterised this right arm of the service, and that some special mark of public acknowledgment is due to some of the many zealous officers who worked so well and vigorously throughout the late memorable struggle. Of the many splendid vessels employed, we notice with much pleasure the screw steam-ship the *Imperatrix*, the property of the South American and General Steam Navigation Company; her engines and boilers are by Fawcett, Preston, and Co., of Liverpool; the vessel by Laird, of Birkenhead. This vessel was taken up by Government, for the transport service, at the end of 1854. She was then just out of the manufacturer's hands; and ever since that time she has been in constant work, and the remarkable success which has characterised all her passages, reflects great credit on the designers and manufacturers of her machinery, as also on Captain Cox and his crew.

On reference to p. 17 of our Volume for 1855 will be found an account of this vessel.

We give below a condensed account of her last four voyages performed between the 12th of April and the 27th of June, 1856, previous to her discharge from the public service :—

	Distance in Knots.			Time under Steam in Hours.		Coals consumed.						Remarks.
	Total.	Per hour.	Per ton of Coal.	Under Way.	At Anchor.	Under Way.		Getting up Steam.		Total for all purposes.		
	Miles.	Miles.	Miles.	Hours.	Hours.	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	
First Voyage. From Deptford to Libua (Russia), calling at Sheerness, Plymouth, and Portsmouth, returning again to Spithead.	2942	8·57	8·79	320¼	222¾	319	9	37	6	356	15	She carried, on this passage, 45 officers, 1,115 privates, 2 women, and 3 children; all Russian prisoners.
Second Voyage. From Spithead to Balaklava.	3301	9·82	8·30	336	216	397	9	35	17	433	6	She took out 2 officers and 5 men, and 88 packages.
Third Voyage. From Balaklava to Malta, returning again to Balaklava ..	2240	9·04	8·81	247¾	112¼	254	0	22	13	276	13	On this voyage she carried 45 officers, 1,095 rank and file, 1 woman; 14 horses, 250 tons baggage, and 20 barrels ammunition.
Fourth Voyage. From Balaklava to Spithead	3291	9·61	7·0	342	46¼	470	5	15	3	485	8	Carrying 42 officers, 1,060 men, 3 women, 1 child; 14 horses, 711 barrels of ammunition, and a large quantity of baggage.
Total	11,774	9·26	8·17	1246	597¼	1441	3	110	19	1552	2	Total, 134 officers, 3,275 privates, 6 women and 4 children; 28 horses.

The following are a few of the principal dimensions of the *Imperatrix* :—

Tonnage	1800 tons.
H.P., nominal	200
Diameter of cylinders	54 in.
Length of stroke (working direct on the screw-shaft)	33 in.
Average number of revolutions, full steam.........	50
Boilers in two pieces, with one funnel.	
Fire-bar surface	210 sq. ft.
Number of tubes	752
Length of ditto	6 ft. 6½ in.
Diameter of ditto	3¼ in.
Heating surface in tubes Per H.P., nominal........	20·8 sq. ft.
Screw, three blades.	
Pitch of screw	23 ft.
Diameter of ditto	15 ft. 4 in.
Length of ditto	2 ft. 4 in.

The cylinders are fixed, working by connecting-rods on one crank, with two air-pumps worked by eccentrics, and two separate condensers.

The admirable style in which this vessel has done her work, reflects great credit on the work, as turned out of hand by Fawcett and Preston. The vessel is handsomely fitted out for passengers, with poop deck, and every modern contrivance. She made her last four passages in running 11,774 miles in 1,246 hours, steaming, on the average, 9.26 knots per hour, steaming 8.17 knots per ton of coal, and carrying 3,419 passengers and 28 horses.

We observe by the "Times" that this vessel has again been taken up by Government to carry troops to the Cape, and that she sailed from Liverpool with nearly a hundred men on board in the last week of July.

"EREBUS" FLOATING BATTERY.

We need hardly remind our readers that we took a very lively interest in the engineering resources which modern mechanical science brought to bear on the late war; that we noticed sometimes with approval, and too frequently we had to disapprove, of the many appliances which the authorities brought into play in the hurry and bustle of the time.

It may be in the recollection of our readers that we pointed out in the earlier stages of progress, some very serious errors which had been committed in the construction of our first floating batteries (said to be the design of our allies the French). These remarks will be found in our Numbers for May and July, 1855. We suppose it is not in human genius, or, at any rate, in public official genius, to arrive at perfection at first or even at an early stage, but that such progress is comparatively slow.

In closely inspecting the *Erebus* Floating Battery, we are happy to state that many of the errors we then pointed out have disappeared; for instance, we noticed how very low between decks the first battery was; the *Erebus* has a clear headway of 6 ft., but still we say this is too low; 6 in., or even 1 ft. more is required, to fight large guns well and comfortably. The fabric of the *Erebus* is of iron, with a lining of wood between decks; the sides are lined with 4 in. plates, planed and jointed; the weather-deck is supported on T iron beams, 9 in. deep, 14 in. apart. The weather-deck is also sheathed with $\frac{9}{16}$ in. plates. There is a style of finish about all parts of this monster battery, which does great credit to her constructor, Mr. R. Napier, of Glasgow. And we could almost regret, as well for the honour and status of the country, that a real trial of strength should not have been made of the practical utility of our gun-boats and batteries. We have no fear but that they would have settled the war in a manner much more to the satisfaction of the great mass of Englishmen, who feel that diplomacy has only compromised a great question, and put it off to a future day.

The machinery of the *Erebus* is also by Mr. Napier, and we can congratulate him upon having had the courage to copy a good design. The engines are locomotive engines, with the piston rods guided as shown in our notes on Steam Machinery Construction, see The Artizan for

April, 1853, page 74. They display in every part first-rate workmanship and great simplicity. The boilers are of the usual style, loaded to 60 lbs., similar to the boilers fitted by Maudslay and Penn, in all the recent high-pressure vessels of war.

The following are a few of the particulars of the *Erebus*:—

THE VESSEL.

Extreme length	188 ft.
Extreme breath	50 ft. 6 in.
Breadth on weather-deck	38 ft.
Depth from weather-deck to keel	19 ft. 7 in.
She is pierced for 14 guns on each side.	
Height from deck to beam	6 ft.
" " to deck	6 ft. 11 in.
Size of ports	2 ft. 8 in. × 2 ft. 10½ in.
Height from water to underside of port	5 ft. 8 in.
Draught of water	7 ft. 6 in.

ENGINES.

Diameter of cylinder	32 in.
Length of stroke	27 in.
Length of steam-port	24½ in.
Width " "	2¾ in.
Diameter of screw shaft	8 in.

SCREW.

Pitch	13 ft. 6 in.
Diameter	8 ft.
Length	3 ft. 0¾ in.

BOILERS (in four pieces).

Number of tubes in each	231
Length of "	6 ft. 10½ in.
Diameter of "	2 in.
Length of fire-bar	7 ft. 6 in.
Breadth of furnace	2 ft. 6½ in.
Diameter of boilers	6 ft. 6 in.
Total heating surface	3,519 sq. ft.
Heating surface per H.P.	17 ft. 6 in.
Total fire-box surface	152 ft. 5 in.
Fire-bar surface per H.P.	76 in.
Number of furnaces	8

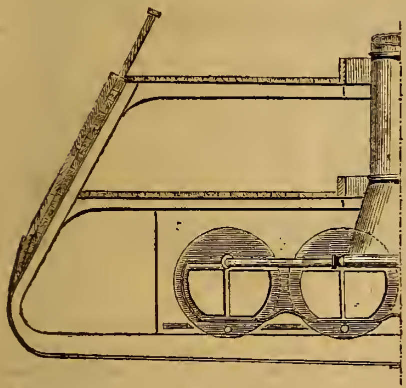


Fig. 1.

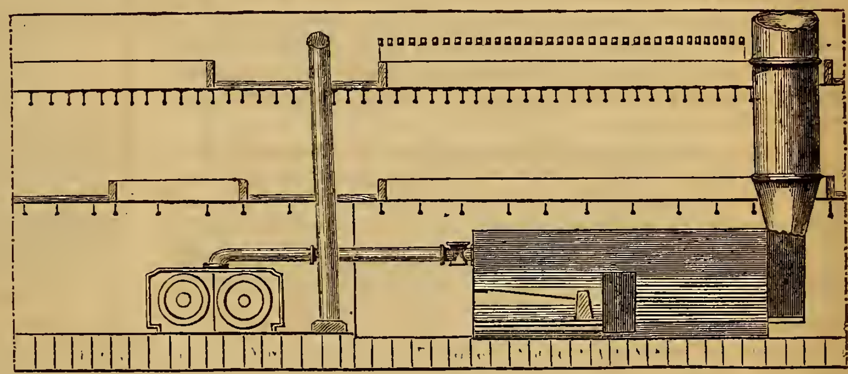


Fig. 2.

In the accompanying illustrations, Fig. 1 shows a section of the ship at forward end of the boiler. Fig. 2, a longitudinal section of the engine and boiler space. These require no further explanation from us.

THE "GENOVA" SCREW STEAMSHIP.

We were present at the trial trip of the above-named screw steamship on the 18th September, and left Gravesend at 12.20 p.m. at half speed, running down the river as far as the Nore light, and returning to Gravesend at about five o'clock.

The *Genova* is the third iron steamship built for the Genoa and Trans-Atlantic Steamship Company.

Our readers will remember our notice of the trials of the *Conte di Cavour* and the *Vittorio Emanuele*, the sister ships built by J. C. Mare and Co., the celebrated iron shipbuilders, at the Orchard Works, Blackwall, and fitted with engines by Messrs. G. Rennie and Sons, of Holland-street, which trials were most satisfactory; and our good opinion of the machinery of those vessels has been fully borne out by the reports received of their performances whilst employed in the French Transport service, from which they are but just disengaged, and have returned to this country to be fitted up, with a view to their taking their places in the service of the new Company, established to open a line of communication between Genoa and Rio, and also between Genoa and New York.

In our present Number we give an extract of the log of the *Conte di Cavour*, which has remained unpublished for some time from want of space.

The enterprise is a spirited one, and thoroughly deserving of success, and great credit is due to the projectors, to Messrs. Pietroni and Co., to Captain Ford, and all concerned; and we are glad to find that the Sardinian Government, alive to the importance of the project, have guaranteed the shareholders 5 per cent. upon their gross outlay. It is also worthy of remark that, excepting Mr. Pietroni and a few large holders of shares in this country, the shareholders are principally Sardinians.

The *Genova* is to open the line to Rio, to be followed by the *Vittorio Emanuele* and the *Conte di Cavour*, when fitted up; the fourth ship is to be named the *Torino*, and will, it is expected, be launched from the Orchard-yard about the 15th of October.

There are four other vessels projected and in course of construction, for the Genoa and New York line, which will be brought forward as speedily as possible.

The *Genova* is an admirable specimen of iron steam-ship building, by J. C. Mare and Co., from designs by Mr. Ash, of the Orchard Yard; the engines and machinery by Maudslay, Sons and Field. It is supplied with the recent approved engine-room fittings, and other conveniences, by Mr. A. P. How; a steam-winch, by Taylor and Co., of Birkenhead, fresh water (condensing) apparatus being fitted in the boiler-room, and also in the cooking galley; in fact, she is fitted with every contrivance tending to the comfort of the officers, passengers, and crew, or in any manner labour-saving.

The engines are horizontal, having two cylinders of 55 in. diameter, and 30 in. stroke, fixed on the same side of the ship, amidship, and working alongside of each other, and through the crank shaft direct on to the screw shaft; the air-pumps, feed and bilge pumps working on the opposite side of the horizontal crank shaft, and balancing the two pistons on the opposite side.

The principal dimensions and particulars of engines, boilers, and ship, will be found below.

The engines at starting worked admirably, but the crank bearing of the forward engine soon became hot, and had to be slackened out, when it gradually cooled down, without stopping the engines.

When working with 10 lbs. pressure, 60 revolutions was the speed against tide, with plenty of steam in the boilers.

The boilers at first primed whilst in brackish water, but when in salt water, and they were well charged, the engines going at full speed, with an increased pressure, and suitable expansion on, all worked excellently well; and hereafter, when the *Genova* has performed a voyage or two across the Atlantic, we may give a report of the performances of the ship and her machinery, which, we doubt not, will do credit to the constructors of the engines and machinery, and to the designer and builders of the ship.

To Captain Ford, formerly of the Ottoman service, aud latterly (and better known by his connection) with the Geueral Screw Company, is due the merit of organising the present line of screw steamers, and also for having superintended the construction of the ships, and of designing their arrangements and equipments, and we are ready to admit that the whole is highly creditable.

The engines and boilers are placed amidships, the screw shaft being about 75 ft. long. There are five bearing blocks; the thrust block has five rings. The screw shaft is made to draw inward about 18 in., so as to unship the screw, which can be hauled on deck through a well-hole of adequate size. The engines are pretty well balanced. The engine-room is roomy, cool, and comfortable, a good foot-place and passage-way being left between the engines. There is fitted to these engines an excellent system of working the expansion; every part of the machinery is perfectly under the eye and hand. The screw shaft tunnel is of iron—roomy and convenient; the system of lubrication well arranged throughout. The four boilers are arrauged in pairs together, the stoke-hole running fore and aft, the boilers being fixed athwartship.

Mr. How's Engine-room Telegraph, his Salinometers, and other contrivanees, have been supplied by him.

A vertical tubular boiler, with sixteen $1\frac{3}{4}$ in. tubes, 4 ft. 6 in. long, is fitted on deck, with a 3-in. cylinder, doukey engine, and pumps. This boiler generates steam for working a Taylor's Patent Winch, for supplying the cooking galley with the means of steaming articles of food, and also a small condensing apparatus for converting salt water into fresh water (about 150 gallons per day) for the use of the crew. The pumps, too, are excellent; indeed, everything on board bespeaks improvement, order, and systematic working.

The *Genova* has a raised forecastle and poop. The forecastle arrangements for the crew and emigraut passengers or troops are excellent. The height between deck and beam 6 ft. 6 in. and 6 ft. 10 in.; the berths, dry, light, and well ventilated, aud well fouud iu water-closets and washing conveniences. The deck saloon is nearly of the length of the poop, and is of the full width of ship. At the stern, on each side of the screw-well, there are state cabins and berths fitted up in elegant style, with every convenience, including baths. The decoration of the saloon is maple and oak, and generally chaste, except the painted glass panels which have been introduced, and which we think out of keeping with the good taste otherwise displayed.

Below, aft, there is auother, but much longer saloon, aud berths, fitted up with every comfort; and beneath this saloon, aud forward thereof, is the screw-shaft tunnel, and eargo space.

The panels of the cabins and berths are so constructed as to ensure perfect ventilation, being vertical louvre boards, behind which a sliding panel, with corresponding opening, is fitted, and this closes or opens the passage for the air. We believe the plan is known as Robinsou's Patent.

In the base mouldings and the cornices perforated metal panels are introduced, and the whole forms a system of ventilation very effective.

Skelton's Patent Tiller is the one fitted on board; but what its peculiarities consist of, we do not recollect to have noticed.

Captain Nepoli, whom we remember to have seen when in command of the *Conte di Cavour*, has been appointed to the *Genova*. He is a smart, intelligent officer, and in every way suited to occupy so important an office of trust and responsiblity.

This trial trip was not one of speed, but simply to test the working of the machinery and to ascertain that the ship was in working trim. It is right to add that, at the time of the trial, there was on board about 1,000 tons of coals and cargo, her draft at the time being 20 ft. Thus, if we take her immersion at 20 ft. load water-line, her displacement would be about 2,788 tons, or less than 1 H.P. (nominal) to each nine tons displacement.

With regard to the screw-propeller fitted to the *Genova*, we are inclined to think, from the working of the engines, that there is not quite sufficient surface in the blades of the screw; and it might be well to watch the working and consider this point, for the sake of economy; and then, if found as we anticipate, remedy the matter by increasing the size of the spare screw.

The following are the principal dimensions of the ship and machinery:—

DIMENSIONS OF "GENOVA".

Built by C. J. Mare and Co. Engines by Maudslay, of 300 H.P., nominal.

	ft.	tenths.
Length on deck	266	8
Ditto between perpendiculars	263	4
Breadth of beam	38	2
Depth of hold to upper deck	26	6
Length of engine space	44	0
Builder's tonnage	$1847\frac{44}{94}$	
Tons: Engine room	not measured.	
Tons: Register N. M.	not measured.	
Tons: Ditto O.M.	not measured.	

Kind of engines, horizontal; ditto boilers, tubular; diameter of cylinders, 55 in.; length of stroke, 2 ft. 6 in.; diameter of screw, 16 ft.; length of screw, 3 ft. 3 in.; pitch of screw, 19 ft. 6 in.; blades of screw, 2; number of boilers, 4; number of furnaces, 12; breadth of ditto, 2 ft. 4 in.; length of fire bars, 7 ft. 6 in.; number of tubes, 1250; internal diameter of ditto, 2 in.; length of ditto, 6 ft.; load on safety valve in lbs. per sq. in. 15 lbs.; date of trial, September 18th, 1856; draft forward, 19 ft. 10 in.; ditto aft, 20 ft.; average revolutions, 61; frames, shape angle iron, 6 in. $\times 4\frac{1}{2} \times \frac{1}{2}$ in. and 17 in. apart in midships; number of strake of plates from keel to gunwale, 15; thickness of plates, 1 in. and $\frac{3}{4}$ in.; number of bulkheads, 8; plates double rivetted; depth of keel, 3 ft. $\times \frac{9}{16}$; cr. plate, and 2 on each side, 1 in. $\times$ 10 in.; independent steam, fire, and bilge pumps; number of masts, 3; barque rigged.

Remarks.—She carries 40 first class, 60 second, and 250 third class passengers. Very strongly built, the stern frame being particularly well hinged and ridged, not the slightest vibration or motion being perceptible whilst the screw was at work. The screw can be disconnected and raised on deck. The ship is rigged with wire rope standing rigging.

WILTON'S IMPROVEMENTS IN FURNACES.

Mr. W. B. Wilton, of the North of Europe Steam Navigatiou Company's works at Lowestoft, recently patented improvements in Steam Engine Furnaces, which have beeu introduced in nearly the entire fleet of ships belonging to the North of Europe Steam Navigation Company, with great success.

A correspondent, who recently visited some of the steam ships of this Company, whilst engaged in the Government transport service, informs us that an economy of 10 per cent. was effected by the introduction of Wilton's improvements, and it is worthy of remark that the engineers of these vessels reported that in their runs from the Thames to Balaklava harbour, they did not have occasion to clean the tubes, as they were found to be perfectly free from carbonaceous deposit and also oxydation internally.

The nature of Mr. Wilton's improvemeuts consists in certain peculiar arrangemeuts, by which atmospheric air is fed to the incandescent fuel in the furnace, and to the flame produced therefrom, at, behind, and above the bridge of the furnace, thereby effecting more perfect combustion, and producing superior heat-giving results from the fuel used.

In the accompanying illustrations, Fig. 1 is a cross-section of a marine boiler, with horizontal tubes; and Figs. 2 and 3 show a side side view and cross-section of the hollow fire-bars used by the inventor.

A, is the dead plate; C, the bridge plate; D, hollow furnace-bars; H, a damper plate for checking draft in front; and K, a regulating plate for checking draft at back of ash-pit, and for cleaning out the space behind the bridge; I, I, are air tubes arranged in horizontal lines at the points indicated; the lower tube, I, is not shown in Fig. 1, being behind the sheet water space over furnace.

The dead plate and bridge piece have each a series of holes therein, corresponding with the passages through the hollow fire bars, and by means of which the air is heated in its passage to the back of the furnace, where, uniting with the gases, the formation of solid incombustible carbonaceous matter is prevented, and a more perfect state of combustion is effected.

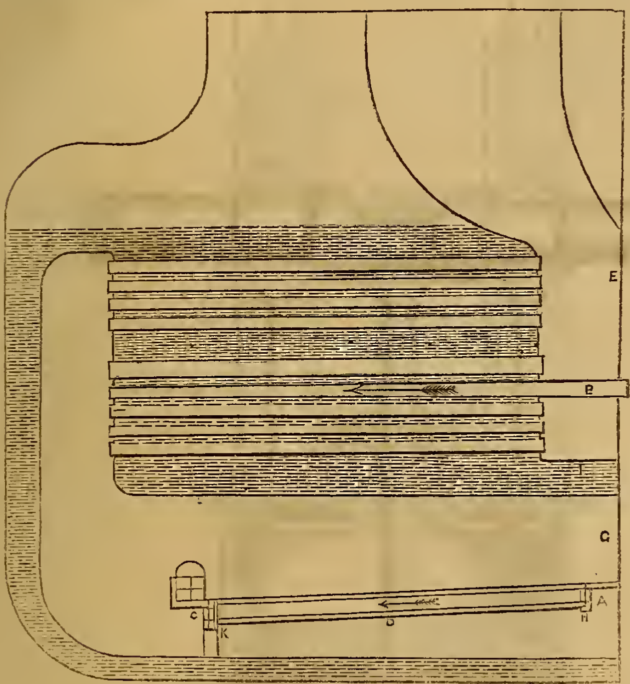


Fig. 1.

Fig. 2.

Fig. 3.

The tubes, I, I, carry in a further supply of atmospheric air at levels above the furnace, and, under regulation, give any further necessary amount of oxygen required for the thorough development of the heat-giving qualities of the gases, the products of combustion.

The hollow bars may be of cast-iron, or, as the patentee prefers, of wrought-iron, for marine furnaces, they being found to last longer whilst they are also lighter.

The facilities for the regulation of the air passages enable the quantity of air proper to the state of combustion in the furnace, to be delivered readily and perfectly under control, and the points of admixture may be varied to suit the qualities of fuels and state of combustion, for when the fires are first lighted, the necessity does not exist for the admission of a large quantity of air.

One of the advantages Mr. Wilton has found, as belonging to his arrangement of hollow fire-bars and air tubes, is the increased coolness of the boiler room.

W. B. YOUNG'S IMPROVEMENTS IN STEAM-ENGINES.

Mr. W. Burgess Young, Engineer, Barnstaple, Devon, has just specified his patent for improvements in the construction of steam-engines.

We have seen a small engine which works very satisfactorily, and Mr. Young has had one in use for about eight months, with a view to test the perfection of the new working parts introduced by him under his patent; and he has the satisfaction to find that every part has done its duty perfectly, without undue wear, and during the entire period, without any loss of power from leakage.

The accompanying views are illustrations of Young's improvements, but for convenience in setting up in the page we have placed the cylinders on end, showing them as working vertically instead of horizontally, as they are shown in his patent drawings.

The following is an abstract of Mr. Young's specification, which gives the inventor's views on the subject of other descriptions of engines, and also describes his invention:—

The importance of bringing the crank shaft as near to the cylinder cover as possible is well understood, and various contrivances have been effected from time to time with that object.

The oscillating cylinder was designed for the purpose, and the trunk-engine is another contrivance by which the same end is attained.

The oscillating-engine, however, is liable to the objection that the entire mass of metal composing the cylinder, cylinder cover, and bottom, slide jacket, and slide gearing, &c., are of necessity obliged to be put in motion at each stroke of the piston, and each revolution of the crank, producing a vibratory motion, throwing undue strain upon the piston rod, crank, pin, and journals, and thereby absorbing a portion of the power which would otherwise be usefully employed.

Moreover, at all times such an engine requires more constant attention to the adjustment of the packings, glands, and working joints and parts; and in a pair of marine engines of large size, the vibration and torsive action due to the constant and rapid alteration of the direction of motion of so great a mass of metal in a contrary direction on each side of the keel does, affect and tends considerably to impair the speed of the vessel.

In the trunk-engine, in which form, whilst it has not the peculiar disadvantages belonging to the oscillating or vibrating-engine, it has nevertheless the disadvantages that the effective area of the piston is reduced by the introduction of the trunk, which leaves only an annular or ring-like surface, upon which alone the force due to the pressure of the steam acts, instead of acting upon the entire area of the piston, and this in the double trunk-engine amounts to a considerable loss of effective power; or it involves the necessity for increased weight of materials for the purpose of giving a greater diameter to the cylinder proportioned to, or to compensate for, the area abstracted by the trunk, whilst in a single trunk-engine the working is unequal on the up and down stroke; moreover, in each case the working friction of the piston is increased, and the number of parts multiplied thereby.

Having only stated the better understood disadvantages of the two forms of engines just described, without going into more minute descriptions thereof, I will now proceed to describe the form of engine as invented by me, as a substitute for the oscillating, trunk, and other forms of engines designed for the purpose of economising space, and bringing the crank shaft closer down to or nearer to the cylinder.

For marine purposes, and particularly for working the screw propeller, the advantage sought to be attained is known to be of the first importance.

For the purposes of my invention I take a cylinder of the ordinary form used for fixed cylinder-engines; but instead of using the ordinary cylinder cover, piston, and piston rod belonging thereto, I substitute a cylinder cover of the following description:—

The cover of the cylinder (the top part of which is surfaced) has an annular recess, accurately bored out to receive an annular ring of metal, as also the hemp or other packing, and the springs, or other elastic material.

On the top of the cover is a metal sliding piece, which, when the engine is in motion, slides from one side to the other, during the revolution of the crank shaft. The top part of the sliding piece is formed with a spherical concavity, to receive about one-half of a sphere, which is partly covered by a gland. The sphere contains a stuffing-box, bored to the required depth; the hole, being afterwards continued through, must be the exact size of the piston rod, so as to allow of its passing through it.

In the cylinder cover is a hole sufficiently long to allow of the oscillation or vibration of the piston rod, and which opening must be rather wider than the diameter of the piston rod.

To the flange of the cylinder is bolted a circular plate or cover, as before described, and a space being provided for the sliding piece, which slides backward and forward during the revolution of the crank, between a metal ring (the inside of which is perfectly planed and made accurate) and the cylinder cover.

The piston rod is connected to the crank pin in a manner similar to that used in oscillating engines, by a T headed block, with brasses, and the other end is connected to the piston in the following manner:—

The end of the piston rod is turned slightly conical, to fit into a corresponding hole bored in the boss, or spherical part of the ball joint, gudgeon, or axle, and is firmly retained there by a cottar, which cottar passes through the boss, and is retained by pins, thereby preventing it from sliding back.

One-half of the bottom ball joint, gudgeon, or axle attachment is fitted into a recess in the piston, and is retained there by a cover, which is made to fit perfectly close, and is securely held down by bolts, which bolts are prevented from unscrewing by a guard frame, which may also be secured by bolts, or otherwise; the joint between the flange and the piston may be kept tight by means of a vulcanised india rubber washer.

In the accompanying drawing, Fig. 1 is a vertical section of a marine screw engine, and Fig. 2 is a cross section of the same.

I have shown in Figs. 1 and 2 the gland of the piston rod as being held down, and tightened by means of two bolts at the sides thereof; but a screwed gland may be substituted therefor, and fitted into the stuffing-box, and which may be set down by means of notches or teeth formed on the head of the gland piece, into which a suitable spanner will take.

I also propose, when necessary, to form the annular rings, slides, and

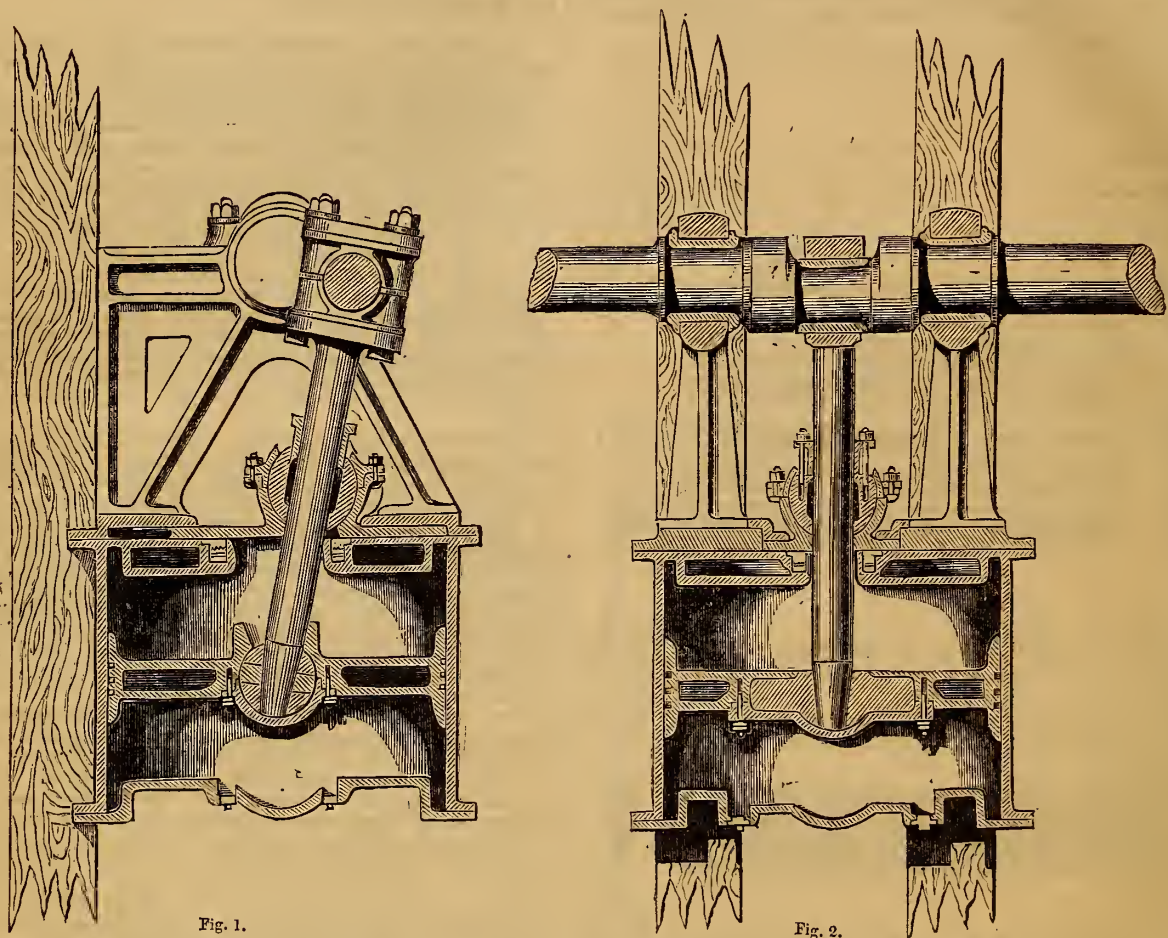


Fig. 1. Fig. 2.

YOUNG'S IMPROVEMENTS IN STEAM-ENGINES.

fittings, on the cylinder cover with a double step, or break, in action, so as more effectually to check and prevent the escape of steam.

It will be seen that engines made according to my invention have none of the grave objections and disadvantages of the oscillating or trunk forms of engines pertaining thereto, whilst the parts added and substituted are surfaces of the simplest form, and are capable of being readily and correctly turned, bored, and planed by machinery, and which may be accurately adjusted with facility.

The crank may thus work close to the cylinder cover, with a piston rod of the shortest length, and without the intervention of a connecting rod, cross-head, guides, or other similar contrivances between them.

The slide valve may be worked direct from an eccentric on the crank-shaft, by placing the valve-chest and connections on the proper side of the cylinder, or it may be worked in any other suitable manner.

Having described my invention of certain improvements in steam-engines, and the manner in which the same is to be performed, I claim as my invention, the application to a fixed cylinder (not having a trunk working therein), of an oscillating or vibrating piston-rod, one end of which is connected to the piston by the means described, and the other end is connected directly to the crank-pin without the intervention of a connecting-rod, slings, or other similar contrivances; and so, by the means described, or the mechanical equivalents therefor, enable the free vibration of the piston-rod through the cylinder cover without the escape of steam therefrom.

EXTRACTS FROM THE LOG OF THE "CONTE DI CAVOUR" SCREW STEAMSHIP.

This vessel belongs to the Sardinian Royal Mail Steam Navigation Company, of which the Genoa and Trans-Atlantic line is a branch establishment. The *Conte di Cavour* and the *Vittorio Emanuele* were the two first ships of the fleet intended to ply between Genoa and Rio, and Genoa and New York. We have already noticed these vessels; and in our present number will be found a notice of the trial-trip of the *Genova*, the third ship, built for the same company by C. J. Mare and Co.

The engines of the *Conte di Cavour* are of 260 H.P. (nominal), by Messrs. G. Rennie and Sons, on their patent direct action principle, and were designed so as to be available for war purposes, or for the mercantile service—the engines, &c., being below the water line.

The effective diameter of the cylinders is 51 in., with a stroke of 30 in.; calculated speed, 60 revolutions per minute; the diameter of screw, 14 ft.; the pitch, 19 ft.

The dimensions of the vessel are as follow:—Tonnage, 1,800 tons; length, 245 ft.; beam, 35 ft.

We have already mentioned the return of this ship to England, after having been engaged in the French Transport Service, since May, 1856;

and we now publish extracts from the log, between April 29th and May 31st, being the time occupied between Genoa and Kamiesch. These extracts require no remark from us:—

SARDINIAN ROYAL MAIL STEAM NAVIGATION COMPANY.—ENGINE ROOM REGISTER FOR APRIL AND MAY, 1856.

Steam Packet "Conte di Cavour." *Mr. James J. Smith, Engineer.*

Date.	Departure from		Arrival at		Height of Steam Gauge.	Revolutions per minute.	Number of hours Steaming.	Consumption of				Remarks.
		h. m.		h. m.	Inches.	No.	h. m.	Coals. tons.	Oil. kil.	Tallow. kil.	Tow. kil.	
April 29	Genoa	4 35 p.m.	....	....	12	61	......	..	..	..	..	Went about 10 miles, to try the speed of vessel; a light wind ahead, going 10 knots.
,, 30	....	....	Marseilles	10 50 a.m.		61	18 10	26	1	1	2	
May 2	Marseilles	1 35 p.m.	Port Corrolle..	5 10 p.m.	13	66½	3 35	4	1	½	½	The distance from Marseilles to Port Corrolle, 46 miles; the vessel going 13½ knots per hour, with two topsails set.
,, 17	Marseilles	1 40 p.m.	....	....	12	60	......	..	..	..	..	Left Marseilles at 1.40; fine breeze fore and aft; canvas set; vessel going, the first 30 hours, 13 knots. Passed the *Great Western* steamship at 5.25 a.m. Arrived at Malta at 4.40 p.m.; *Great Western* arriving 2 hours later.
,, 18	....	....	....	....	12	59						
,, 19	....	....	....	....	13	60						
,, 20	....	....	Malta	4 40 a.m.	13	60	63 0	72	5	3	4	
,, 21	Malta	5 0 a.m.	....	....	12	60	......	..	..	..	..	We passed the *Great Western* on the 24th, at 4 a.m., in the sea of Marmora, beating her 17 hours from Malta to Constantinople.
,, 22	....	....	....	....	12	61						
,, 23	....	....	....	....	13	62						
,, 24	Constantinople	7 40	Constantinople	5 45 a.m.	14	64	......	..	..	..	..	We left Constantinople at 7.40; at 12 had to blow the water out of one of the boilers; a large piece of wood got in the feed-valve; stopped 3 hours.
,, 25	....	....	....	....	14	64						
,, 26	....	....	Kamiesch.	2 30 p.m.	13	63	165 30	224	16	8	6	

June 1, Left Kamiesch, 5.36, with a large ship in tow; passed one of the West India Mail boats towing a ship. Our ship a great deal larger than his; went slow all night; very foggy.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Twenty-sixth Annual Meeting.

ON THE INUNDATIONS OF RIVERS.

By Henry Hennessy, M.R.I.A., Professor of Natural Philosophy in the Catholic University of Ireland.

My attention was called a few years ago to certain misconceptions which frequently prevail as to the relative importance of obstructions to the flow of rivers, whereby inundations of their banks are caused, or at least greatly promoted. The views I was induced to form by the study of the local phenomena coming under my notice having a more general application, I venture to bring them forward in this short paper.

It is well known that in general a river in a condition fit to carry off the water falling in its basin should have certain conditions of transverse and longitudinal section. The former should gradually enlarge from the source, and the outline of the latter should be concave upwards, so as to diminish in slope towards the river's mouth. These conditions the natural action of a river upon its bed contiuually tend to bring about, but many of the operations of man produce effects entirely opposed to this natural tendency of the rivers themselves to form good main drains. It is true, the physical structure of the country through which a river passes may also interpose very serious obstacles to the action just referred to; but here I propose to consider chiefly the action of artificial obstructions. Of these by far the most remarkable are weirs and bridges. Under ordinary circumstances, when the waters of a river are at their usual level, a weir produces a very obvious effect in raising the waters of a river, so that many persons would be at first disposed to regard them as the most important artificial obstructions during a freshet. This arises from confusing the objects for which they are erected with their influence under every possible condition of a river. A weir is designed expressly as an obstacle to the flow of the water, while other obstructions may not be erected for that immediate object; therefore, while the latter only connote an obstructive influence, it is pointedly denoted by the former. Still, in general, when the waters of a river increase, the influence of bridges of more than one arch or pier is far greater than that of weirs. Let us suppose a weir and a bridge of more than one arch, each spanning two different rivers, A and B, at points where the breadth, depth, and velocity of current are precisely the same in both. Let the weir be placed at right angles to the direction of the current in A—that is, in the most favourable position for producing a high swelling. When the water in both rivers is low, the weir will generally produce a greater swelling than the bridge; when the surfaces of both rivers become elevated, so that in B the water reaches the tops of the piers of the bridge, the additional sheet of water thus superimposed on that already partly kept back by the bridge will, from its superior mean velocity, be still more dammed backwards, and will consequently tend in a greater proportion to augment the existing swelling. At the same time the corresponding additional sheet of water superimposed on the surface of A, will not meet with any resistance from the weir. When the surface of the water in both rivers becomes still more elevated, so as in B to rise above the springing of the arches of the bridge, the ratio of the contraction to the volume of water passing through will rapidly increase, while at the weir the same ratio will continue to diminish. If, however, the weir should be placed very obliquely to the directiou of the current—a position in which weirs are almost always built—a slight rise in the water would produce considerable increase of section; in other words, more space for the passage of the water over the weir, so that in this case the superior obstructive iufluence of the bridge becomes still more manifest. Thus, although a bridge of several arches and piers is generally less effective than a weir in obstructing the flow of a river in its ordinary state, during extraordinary floods (especially if the arches are numerous and low) the bridge will be far more influential in keeping back the superabundant waters.

These views are very remarkably illustrated by a series of facts which came under my notice in connexion with a remarkable flood of the river Lee at Cork. The central portion of that city is situated on a flat island, the surface of which is but little elevated above the level of the two arms of the river by which it is embraced. Under ordinary circumstances it is thus liable to be overflown by a slight increase in the height of the surface of them. Above the city the river is crossed by seven weirs connected with mills and fisheries, and its banks are spanned by nine bridges, of which six are bridges of three arches. The opinion most prevalent as to the influence of all these artificial obstacles to the flow of the river was, that the floods were chiefly caused by the actiou of the weirs. In November, 1853, a flood more than usually calamitous occurred, whereby life and property were destroyed, portions of the quays and one of the most important of the bridges ruined. The force of the current in sweeping over the inundations just above the city was so great as to overturn many walls and earthen fences, and to scour the surface of the roads so as to make them look for some time afterwards like the dried beds of rivulets. Deep excavations were ploughed up in the bed of the river, and large angular blocks of stone were swept along and deposited in heaps wherever there was comparatively still water. So prevalent was the opinion as to the injurious influence of the weirs that notice was formally given, in the usual way, for an Act of Parliament for their entire removal, despite the opposition such a step would encounter from their proprietors, and the necessarily large outlay that would be required to compensate the destruction of so much valuable property. A careful examination of the facts, and a series of calculations of the comparative effects of the different weirs and bridges, the results of which are contained in a report drawn up by me and printed by the Cork Harbour Commissioners, clearly proved, without any exception, that the bridges, and not the weirs, were far more important obstacles to the overflowing river. The possibility of some of the weirs situated far above the city being useful, by distributing the waters and preventing their rapid advance, was also pointed out, a view which seems to be now in some measure adopted by the French Government with reference to the great inundations of France. The matter was thus immediately set at rest, for the corporation prudently withdrew their notice, and, instead of removing the weirs, have since determined on removing one of the bridges which I had pointed out as most obstructive of all. Two others, which I had placed nearly in the same category, do not come, I believe, under their jurisdiction, being outside the borough. The obvious remedy in such cases will, I understand, be adopted. namely —the substitution of a single flat arch, or a lattice or tubular bridge, for one of several arches. The destruction of bridges of many arches so frequently accompanying floods, seems to point also to a similar remedy; and I cannot hesitate from formally declaring my conviction that many advantages would result by the general adoption, for rivers liable to great fluctuations in the quantity of water passing through their channels, of bridges with a single wide opening, and that spanned either by a very flat arch or a lattice or tubular beam. Although the invention of these structures has more immediately arisen out of the extension of railways, they appear far more specially applicable to such cases as the crossing of rivers liable to floods.

When a river discharges itself into a tidal estuary, its floods will be affected by the state of the tide, and thus a variable natural obstacle arises to the flow of its waters. If we at first abstract the influence of the fresh water, the tidal wave will move up the channel with a height and velocity which will be an inverse function of the breadth. Whenever the velocity and volume of the tidal wave are greater than those of the river, a very serious augmentation of the height of the fresh water surface may be expected. In ordinary states of most tidal rivers, when the volume and velocity of the fresh water are both inconsiderable, the tidal wave acts precisely like a weir. During a great flood the tidal wave would still act as a weir, but with inferior proportional results, partly from the same cause as that already remarked when speaking of these structures, and partly, also, because the summit of the tidal wave itself might be forced backwards to a lower part of the channel than that to which it would otherwise attain. As the height of any point of a swelling produced by any obstacle to the current of a river decreases with the distance of that obstacle from the point, the height of the flood in the upper parts of the tidal river would be diminished from this cause. But as most rivers widen towards their mouths, the farther down the summit of the tidal wave the greater will be the section for the water to pass over it. These views were illustrated by what took place during the flood of the river Lee. This river discharges itself into a tidal estuary a little below Cork, and in the usual conditions of the river the height of the fresh water is affected by the tides for, at least, a mile above the city. The flood of 1853 attained its maximum height between twelve and one o'clock in the day, and it was high water of an extraordinary spring tide at half-past five p.m. At this hour the volume and velocity of the fresh water was still so great, that very little alteration in the rapidity of the current was produced on the backwater action of the high tide. Six hours afterwards, at midnight, the fall of the surface of the river was slight, although it was then low water of a spring tide. The height of this tide with the river in its usual state would be such as alone to slightly inundate a small part of the city, as such spring tides have frequently done; it is, therefore, evident that if the summit of the tidal wave had not been to some extent pushed downwards to a wide part of the estuary by the momentum of the fresh water, the combined effect of both might be an inundation still greater than that which had occurred at an earlier period of the day.

REPORT ON THE MEASUREMENT OF WATER, BY WEIR BOARDS.

By James Thomson, C.E.

Read before Section G. on Saturday, August 9.

The substance of this Report will be given in our next, as also the discussion thereupon.

ON A COMMUNICATION BETWEEN THE ATLANTIC AND PACIFIC OCEANS BY THE ATRATO AND TRUANDO RIVERS.

A Paper by Mr. F. M. Kelly, of New York.

Read before Section G. at Cheltenham, on Monday, August 11.

This was an exceedingly interesting Paper, by Mr. Kelly, upon the practicability of forming a ship canal without locks, by the valley of the Atrato, and thus easily effecting a junction between the two oceans.

The Paper was illustrated by a series of maps, and the plans of the survey made for Mr. Kelly, several of which we remember to have seen suspended on the walls of the Institution of Civil Engineers and the Royal Geographical Society.

Our readers will find the substance of this Paper by referring to The Artizan for June last, in which we gave a careful abstract.

The subject is very interesting, and we trust that ere long some active measures will be concerted between the Governments of the United States, Great Britain, France, and other European countries for the execution of a ship canal across the American continent.

ON THE MANAGEMENT OF MERCANTILE VESSELS.

A Paper by R. Methuen, F.R.G.S.

Read before Section G. on Monday, August 11.

This Paper, which was of considerable length, possessed but few points of interest to our readers, and cannot be given at present; but we may hereafter give extracts therefrom, as opportunity serves.

SECTION G.—Cheltenham, Tuesday, August 12, 1856.

Amongst the papers read to-day, of which the following is a list:—

Section G.—*Mechanical Science.*

The Earl of Harrowby.—Report of the Patent Laws Committee of the British Association.

W. A. Macfie.—On the Patent Laws.

A. Henderson, M.S.A., C.E., M.G.S.—Report on the Condition of Life Boats and Fishing Boats, and the means of establishing them round the Coast.

Major Vincent Eyre.—On the Application of Corrugated Metal to ships, boats, and other floating bodies.

W. Clay.—On the Manufacture of the large Wrought-iron Gun, and other masses of Iron made at the Mersey Iron Works, Liverpool.

William Smith, C.E.—On Improved Mechanical Means for the Extraction of Oil, and the Economical Manufacture of Manures from fish and fishy matter.

Dr. Sibbald.—On a New Plan for a Ship Communicator.

We can only at present find space for the Earl of Harrowby's report (Mr. Macfie's letter on Patent Laws was given in our last). Extracts from the other papers will be given hereafter. Mr. Rankin's report on Strength of Girders will be given in our next.

ON A METHOD OF UNITING IRON WITH IRON AND OTHER METALS WITHOUT WELDING.

A Paper by Dr. Greene, read before Section G., on Monday, August 11th.

This paper was by the same gentleman who read a paper on Saturday, and described a railway brake, which, like the present invention, is also by M. Sisco, of Paris.

Dr. Greene exhibited some very large chain links, square in section, composed of strips or bands of flat hoop iron wound round a mould, also models of axles, tubes, and other articles similarly constructed.

Dr. Greene's paper was very brief, and merely stated that the system of combining or joining metals, and thereby obtaining a higher amount of strength, uniformly, than from solid metal for the same weight, was simple and easy of performance; it was the invention of M. Siseo, a poor, but ingenious mechanic in Paris.

Dr. Greene asserted that he could not only vouch for the novelty and ingenuity of the invention, but also as to its practical and commercial value, when used for the making of chains, for cables and other purposes, and for various other purposes where lightness and strength form a desirable combination.

The process described by Dr. Greene is as follows:—

Take the hoop or other kind of iron to be used, and if it be coated with oxide, use a bath of hydrochloric acid and water, in which immerse the article to be cleansed, and when sufficiently pickled take it out and wash it perfectly clean in water; next, prepare a boiling solution of borax and water, into which dip the article which has been manufactured into shape, and held together by binding wires; when this has been done, take the article and dip it into a bath of molten metal or brazing mixture kept in a state of fusion.

M. Sisco recommends a composition of brazing metal for cementing together strong masses of wrought-iron, which is prepared as follows:—take 100 parts of soft refinery pig iron, 33 parts of copper, and 16 parts of the black oxide of manganese.

After the article has been immersed for a sufficient time in the bath of metal, it is taken out, wiped off externally, and allowed to cool, when the whole mass will be found combined or cemented together.

Dr. Greene also claimed for M. Sisco the invention of making the links of chains from a continuous round wire or flat metal band, which were afterwards cemented together, or brazed to consolidate them; and he also claimed the making of axles, tubes, and shafts by the winding-up of sheets of iron, and the combining together of bars and rods, and rods and tubes, for those purposes, and soldering or brazing them together to form a compact mass.

After Dr. Greene had read his paper and exhibited the specimens on the table, and explained their peculiarities to the meeting, Mr. William Smith, C.E., called the attention of the President and Committee of Section G. to the fact that each of the parts of the invention described by Dr. Greene as so novel and ingenious, were some of them old and in use, and patented about 1838; others, again, were patented in this country three to five years ago. Mr. Smith stated that the making of chain links from iron wire and iron hoop, and afterwards cementing or brazing the parts together, was patented in England by Mr. Andrew Smith, the inventor and first patentee of the wire rope, now seventeen or eighteen years ago. He remembered the experiments and testings at Woolwich Dockyard about that period; but instead of the section of the link being square, as in Sisco's—which shape would never do in practice, as a cable so constructed would kink and break—the links were formed perfectly circular in section by the peculiar form into which the strip of iron was cut, and from the winding-up of which, upon an oval mould or link die, the perfectly circular section was obtained.

The form of the strip of metal for this purpose was stated to be the section of a long parabolic spindle, a rule being given for setting out the length and taper of the strip in proportion to the size and diameter of the link; and these links were formed upon a very ingeniously contrived "part mould," or "core piece," which allowed of a series of these links being formed one within the other.

Wire links were formed in a similar manner upon "part moulds," and afterwards brazed by dipping into a metallic bath composed of a somewhat different mixture to that described by Dr. Greene.

Mr. W. Smith added, that with reference to the compound axle and tubes, those also he was aware had been patented in the year 1853, by Mr. A. S. Stocker and by Messrs. Burke and Stocker, and they were precisely what Dr. Greene had described, and exhibited specimens of, to the meeting as the original inventions of M. Sisco, of Paris.

Mr. Smith concluded by stating, that much as he regretted having to come forward and take from an inventor, who fancied himself "the first and true" inventor of the particular invention, any merit attached thereto, still he felt it to be his duty to the President and Committee of Section G. to state that which he was cognisant of, and to prevent the public from being misled from the circumstance of the paper having been thought worthy of being allowed to be read in this Section—more especially as the entire paper was nothing more than a retailing of old inventions to the members of the British Association and the public as new ones.

It happened rather unfortunately for Dr. Greene that the subjects of both the papers read by him had met with pretty much the same fate; but Mr. Smith trusted that the learned Doctor would forgive his pointing out the serious defects of Sisco's brake as described on Saturday last, and for now totally stripping the subject of his present paper of all merit and originality.

The President said, that for himself and on the part of the Committee of Mechanical Science, he had to thank Mr. Smith for having pointed out the facts mentioned by him in connexion with the chain and the other articles made as described by M. Sisco; and he added that it was a great advantage to the Section to have the able assistance of a gentleman so well acquainted with the progress of practical science.

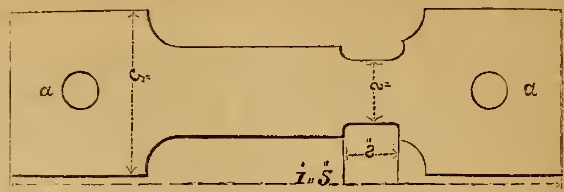
ABSTRACT FROM MR. FAIRBAIRN'S REPORT, ON THE STRENGTH OF WROUGHT-IRON PLATES AND BARS AT DIFFERENT DEGREES OF TEMPERATURE.

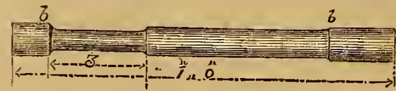
Read at the Meeting of the British Association—Section G.

By the present series of experiments it was sought to determine the influence of temperature on the tensile strength of wrought iron. The subject is one of considerable importance, not only as forming a sequel to the author's former experiments on cast iron at different temperatures, but also as affording valuable data in regard to the security of steam-boilers and other constructions—in which wrought iron is subjected to severe strain under the varying conditions and changes of high and low temperatures. To determine this point two series of experiments were undertaken—one on boiler plate, the other on bars of the best rivet iron.

The pieces experimented upon were suspended from the end of a powerful lever, and their lower ends were immersed in baths of water, oil, &c., to regulate the temperature.

The pieces of boiler plate were of the annexed form, 17 in. long and 5 in. wide, reduced to 2 in. at the part immersed in the liquid in the bath to ensure fracture at that point. They were also held in the shackles by bolts passing through eye-holes, *a a*.





The bars of rivet iron were broken in a similar manner, but instead of being attached to the shackle by bolts they were fixed by clips embracing the shoulders, *b b*. The bars were 1 ft. long, and their least diameter 9-16th to ½ an in.

The experiments on plates gave the following results:—

Temperature Fahrenheit.	Strain applied in the direction of the fibre.			Strain applied across the fibre			Remarks.
	Number of Experiments.	Breaking weight per sq. in. of sectional area in lbs.	Elongation of 10½″ in parts of an inch.	Number of Experiments.	Breaking weight per sq. in. of sectional area in lbs.	Elongation of 10½″ in parts of an inch.	
0°	1	49,009	·14				* A hollow in plate filled with cinder, fracture very irregular.
60°	3	50,219*	·2	2	43,406†	·1	† Spots of bright steel, like iron.
111°	5	42,088	...	4	44,860‡	·13	‡ Fracture very irregular.
212°	6	49,500§	·22	7	45,680	·11	§ Slightly defective plate.
270°	8	44,496	·13	...	...		‖ Broke as this weight was laid on. The true weight is therefore *below* that given.
340°	9	Failed.	...	10	42,088	·15	
395°	11	46,086	·15	...	...		
Nearly red.	...	...	...	12	38,032	·15	
Dull red.	...	...	...	13	(30513)‖	·23	

From the above it will be seen that the maximum strength is attained when the iron is heated to 212°. In those torn asunder, in the direction of the fibre, the maximum is at 60°; but allowing for the defective state of the plate, in experiment 6, we may consider the breaking weight at 212°—as 50,000 lbs. per sq. in.—when the strain is applied in the direction of the fibre, and 45,600 lbs. across it. Taking the mean of these two, we have 47,800 lbs., or 21¼ tons, as the average strength per sq. in. of section at the temperature of boiling water, which is rather higher than the mean strength at 60°.

The following table gives the results of the experiments on rivet iron:—

Number of Experiments.	Least Diameter of Bar.	Temperature Fahrenheit.	Breaking weight per square inch of sectional area in lbs.	Elongation of 3″ in parts of an inch.	Remarks.
1	$\frac{9}{16}$	— 30°	63,239	·8	
2	,,	+ 60°	61,971	·82	A large spot of bright steel like iron.
3	,,	60°	63,661	·56	Pulled out at shoulder, bright spots.
4	,,	114°	70,845	·56	Pulled out at shoulder.
5	,,	212°	...	...	Cut into the shackle. Experiment discontinued.
6	½	212°	74,153	·47	Bar very defective, a large longitudinal fissure.
7	$\frac{9}{16}$	212°	80,985	·66	
8	½	250°	82,174	·6	
9	$\frac{9}{16}$	270°	83,098	·51	
10	½	310°	80,570	·63	
11	,,	325°	87,522	·6	
22	$\frac{9}{16}$	415°	81,830	·64	
13	,,	435°	86,056	·74	
14	,,	Red by day light.	(36,076)	·55	Broke as this weight was laid on. This weight is consequently too high.

Experiments 3 and 4 give results rather too low as they drew out at the shoulder; in all the other experiments the corner at the shoulder was rounded off, so as to insure the bar breaking across at its smaller diameter immersed in the bath.

In comparing the results of these series of experiments, it is remarkable that whilst the boiler plates attain their maximum strength at about 212°, the rivet iron does not reach its greatest strength till it is heated up to 300°, or even higher. The rivet iron, however, appeared to be of a somewhat *irregular* quality. Extreme degrees of cold do not appear to affect the strength of wrought iron very materially, though it would probably be unsafe to subject it to blows or impact under such circumstances. Cast iron is always brittle, and liable to fracture at low temperatures, especially where unequal tension is induced by irregular contraction. At red heat the strength of wrought iron is far more seriously injured than that of cast. These different influences of temperature on wrought and cast iron might have been expected from a consideration of the different molecular arrangement of the two bodies.

REPORT OF THE PATENT LAW COMMITTEE OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Made 12th August, 1856.

At the meeting of the British Association held in Glasgow (September, 1855), a committee, consisting of the Earl of Harrowby, the Duke of Argyll, Sir David Brewster, W. Fairbairn, Thomas Graham, Colonel Sabine, and Thomas Webster, was appointed, on the recommendation of the Mechanical Section, "for the purpose of taking such steps as may be necessary to render the patent system of this country, and the funds derived from inventors, more efficient and available for the reward of meritorious inventors, and the advancement of practical science."

This committee, after reviewing the position of the question, in reference not only to the report of their immediate predecessors, the committee appointed at the Liverpool meeting of the British Association, but to the proceedings at former meetings of the Association, and of other parties, at the Society of Arts, the Manchester Committee (presided over by your Vice-President, Mr. Fairbairn), and the United Inventors' Association, and the powers existing under the "Patent Law Amendment Act of 1852," presented the following Memorial to the Lord Chancellor:—

"*To the Right Honourable the Lord Cranworth, Lord High Chancellor of Great Britain.*

"The undersigned members of a committee of the British Association for the advancement of Science beg leave to present the following statement to your Lordship:—

"The amendment of the patent laws, and the encouragement to be thereby afforded to practical science, has from time to time occupied the attention of the British Association for the advancement of Science. At the meeting of the Association in Glasgow, in September last, the following resolution was passed:—

"'That the Earl of Harrowby, his Grace the Duke of Argyll, Sir David Brewster, Colonel Sabine, the Master of the Mint (T. Graham), William Fairbairn, and Thomas Webster, be a committee for the purpose of taking such steps as may be necessary to render the patent system of this country, and the funds derived from inventors, more efficient and available for the reward of meritorious inventors, and the advancement of practical science.'

"At the meeting of the British Association at Liverpool, in the preceding year, a similar resolution was passed, appointing a committee, also presided over by the Earl of Harrowby.

"The report of that committee to the meeting of the Association at Glasgow, and the proceedings thereon, are sent herewith.

"In that report, and in the discussion to which that report and another communication on the patent laws gave rise, at the Glasgow meeting of the British Association, attention was directed to various defects in the present system, all, or nearly all of which had been the subject of evidence before, and of consideration by, the Select Committee of the House of Lords, in 1851, on the Patent Bills of that session. These defects were intended to be provided for by the 'Patent Law Amendment Act, 1852,' establishing the present system, and it is believed that the greater part of them are capable of being dealt with by a liberal interpretation and administration of the powers of that Act.

"The first section of that Act provides that the Lord Chancellor, the Master of the Rolls, and the law officers for England, Scotland, and Ireland respectively, together with such other person or persons, as may be from time to time appointed by her Majesty, shall be 'Commissioners of Patents for Inventions.'

"The first report of the Commissioners of Patents contains the following passage:—'The law officers of Scotland and Ireland not being in England at the commencement of the Act, took no part in the proceedings (*i. e.*, of bringing the Act into operation), and as the functions of those officers, in respect of patents for inventions, are entirely abolished, it is not to be supposed that they (the law officers of Scotland and Ireland) will be called upon at any future time to act as Commissioners.'

"In reference to the result of this interpretation of, and proceedings under, the Act, and of the non-appointment of any other person or persons as a commissioner, or as commissioners for the administration of the new system, the report of the Liverpool Committee says:—'That system has been so arranged as to exclude the law officers of Scotland and Ireland from its administration, and to devolve the responsibility on the Lord Chancellor, the Master of the Rolls, and the Attorney and Solicitor-General of England, whose other official duties are so numerous and engrossing as to prohibit their affording that attention to the development of a system, confessedly so difficult as to be incapable of adequate administration, without the co-operation of persons practically acquainted with the requirements of the system intended to be established, and for the establishment of which ample provision and powers are contained in the Act.'

"The Committee of the British Association, having regard to the inherent difficulty of the subject, and to the number of questions, either of administration or of legislation, adverted to in the accompanying report, and at the Glasgow meeting of the British Association, respectfully suggest that her Majesty should be advised to appoint some other persons as Commissioners of Patents under the 'Patent Law Amendment Act, 1852,' or that the working of that Act should be the subject of immediate inquiry.

"(Signed) HARROWBY.
ARGYLL.
EDWARD SABINE.
THOMAS GRAHAM.
WILLIAM FAIRBAIRN.
THOMAS WEBSTER.

"London, March 11, 1856."

The Lord Chancellor has recently expressed, through the Earl of Harrowby, a willingness to comply with the prayer of the memorial, on being distinctly informed and satisfied as to what such commissioners would be expected to and could do. To this the committee of last year have not had the opportunity of making any reply; but they are encouraged by various circumstances to believe that these and similar efforts, if persevered in, will not be in vain, and that the reform of the patents, which in the first address of your first president, the Rev. Vernon Harcourt, was pointed out as one of the subjects to which a scientific Association might be justly expected to call public attention, and which has repeatedly been brought before your meetings, will, ere long, be recorded as one of the many results of the British Association.

A discussion then took place, in which Messrs. W. Grove, Q.C., William Fairbairn, and others took part, and on the motion of Thomas Webster, seconded by P. Le Neve Foster, the following resolution was passed:—"That the Earl of Harrowby, Lord Stanley, M.P., James Heywood, M.P., the Master of the Mint (T. Graham), William Fairbairn, General Sabine, and Thomas Webster, be a committee for the purpose of taking such steps as may be necessary to render the patent system of this country, and the funds derived from inventors, more efficient and available for the reward of meritorious inventors and the advancement of practical science."

THE MONSTER WROUGHT-IRON GUN.

On Tuesday, the 12th of August, Mr. William Clay read before section G. a paper, descriptive of the manufacture of the large wrought-iron gun made at the Mersey Iron Works, Liverpool; and on other large masses of wrought-iron.—After some general preliminary remarks, Mr. Clay proceeded to describe the process of manufacture; and the following is an abstract of the paper:—

The first thing necessary was to decide the description of iron of which the gun was to be made, and I selected a strong clear iron, puddled from the strongest pigs I could obtain, taking care that the iron should be worked as little as possible before it came to be put into the gun. A core was first prepared, the full length of the gun, and a certain diameter; this core, be it remembered, was meant to be bored out; a series of bars were then packed round this core, and again heated and forged to the proper shape; another series of bars was packed over that, and heated and worked perfectly sound. It still required another layer of bars, placed longitudinally, and even then was far from the size required.

The forging, although thus larger than any ever made, required to be augmented in its diameter at the breech by 12 in., which was accomplished by two layers of iron, placed in such a manner as to resemble hoops; and this being welded sound, the forging of the gun was completed.

The boring was effected in an ordinary powerful lathe, the first bore being 11 in. diameter, consisting of a drill of 7 in. diameter, and a face cutter of 2 in. The second cut was $\frac{5}{8}$ in. on each side, making the bore $12\frac{1}{4}$ in.; and the third, or finishing, cut of $\frac{1}{4}$ in., finished the bore. I beg leave to exhibit samples taken from the borings, of which I shall further speak when I come to the much-vexed question of crystallisation. I may remark that the boring was not a work of very great expense and labour; on the contrary, the boring went on so rapidly that I was unable to prepare the fresh boring-heads fast enough. The trunnion-hoops were made in separate rings, and were struck upon the body of the metal.

Having described the manufacture of the gun, I beg leave to read the report of the trials of the gun, on the North Shore, near Liverpool, by Captain Vandeleur, Gunnery Instructor at the Royal Gun Factories, Woolwich, merely omitting that portion describing the manufacture of the gun, which I have already laid before you:—

Report on Messrs. Horsfall's Monster Wrought-Iron Gun.

Sir,—Having, according to your directions, proceeded to Liverpool, on May 21, and witnessed the experiments on the two following days with the 13-inch wrought-iron gun, manufactured by Messrs. Horsfall, and about to be presented by them to Her Majesty's Government, I have the honour to communicate the following particulars concerning the gun, and detail of the experiments. The monster gun consists of a single piece of wrought-iron, with the exception of the trunnions; these are fixed to a large hoop surrounding the body of the gun, shrunk on. This hoop is likewise kept in its position by a "securing" hoop. The following are some of the chief dimensions:—Length of gun, 15 ft. 10 in.; diameter of base ring, 3 ft. 7½ in.; diameter of muzzle, 2 ft. 3½ in.; diameter of trunnions, 3 ft. 3¾ in.; diameter of trunnion-hoop, 4 ft. 2¼ in.; length of bore, 13 ft. 4 in.; diameter of bore, 13·05 in. The present weight of the gun is 21 tons 17 cwt. 1 qr. 14 lbs. The mass of wrought-iron of which the gun was made, before turning or boring, and without the trunnion-hoop, weighed upwards of 25 tons.

A rough carriage and platform, of a very suitable description, was constructed for it by Messrs. Horsfall, on which the gun was placed, at a point of the north shore of the Mersey, about 9 miles north of Liverpool, near Formby Lighthouse. To get it into position, the gun had to be transported over the sand for 300 yards, which, notwithstanding the great weight and the softness of the sand, was successfully accomplished. The requisite ammunition and small stores having, by your direction, been furnished by this department, the trial of the gun took place on May 22, at the request of the owners; two preliminary rounds, with light charges, were fired, after which the two proof rounds, with the charges I recommended, viz.—45 lbs. powder, and a service shell filled with lead, and one wad. The gun having stood these tests in a most satisfactory manner, further experiments were carried on during the following day, for the purpose of ascertaining its range and accuracy. A report of the practice on each day is annexed.

Messrs. Horsfall were desirous of ascertaining what would be the effect of such large projectiles as their gun is capable of throwing against the wrought-iron plates used in the construction of our floating batteries; one round was, therefore, fired against one of these plates. The dimensions of the plate were 3 ft. 9 in. by 2 ft. 9 in. (weight 17 cwts.), by 4⅝ in. thick. This was placed at a distance of 120 yards from the gun, and was supported by nine balks of timber, 6 ft. long by 14 in. square, against the ends of which the plate was fixed; the timbers were secured by nailing cross planks to them, and piling the sand around.

The gun was laid at point blank, and loaded with 25 lbs. powder and a solid shot, weight 282 lbs.; it struck the plate a little to left of the centre, and drove the portion against which it struck to a distance of 300 yards, one-third of the plate was broken off, the shot was also broken, and the fragments scattered around, some of them falling 200 yards to the left of the target; the timbers were driven to some distance.

Owing to the peculiar form of the traversing platform, much difficulty was experienced in altering the direction of the gun; this will account for the deflection right and left, as shown in the annexed table of practice. Had greater facility for traversing existed, I have little doubt that each shot would have struck a target, 12 ft. square, at a distance of 2,000 yards.

This gun has been manufactured by Messrs. Horsfall at an expense of £3,500. As the condition on which they originally offered it to Her Majesty's Government—that of being used against the enemy—can no longer hold good, these gentlemen are willing to put it at the disposal of the Government for further experiment free of all expense. Their only wish is, that Her Majesty's Government should declare the gun to be fit for service, and, by so doing, acknowledge that Messrs. Horsfall have been successful in their undertaking, and have accomplished that which by the scientific world has hitherto been deemed impracticable—the construction of a sound 13-inch wrought-iron gun.

Arthur Vandeleur, Capt. Inst. R.G.F.

Royal Gun Factories, May 26.

Report of Experimental Practice, at Liverpool, with Messrs. Horsfall's Wrought-Iron Gun.

Direction of range, N. by E.; direction of wind, N.E.; force of wind, 3.

No. of rounds.	Height of gun above plane.	Nature and wt. of ordnance.	Charge. lbs.	Weight of projectiles. lbs.	Elevation.	Time of flight.	Recoil. ft. in.	1st graze. yards.	Ultimate range. yards.	Deflection. Left. yards.	Deflection. Right. yards.	Remarks.
1	12 ft.	Wrought-iron 13-inch gun, 21 tons 17 cwt.	20	196	10°	11″	3 0	3000	3350		not ob- served	Fired May 22.
2	,,		30	282	,,	10″	5 0½	3300	3750			
3	,,		45	310	,,	12″	7 10	3550	3900			
4	,,		45	318	1°	3″	5 4	930	5000			
5	,,		25	282	P B	—	4 4	struck	target,	a wro	ught-	iron plate.
6	,,		,,	,,	6¾°	8″	2 8	2030		10		Fired at flag-staff, 2000 yards distance.
7	,,		,,	,,	6⅓°	,,	2 9	1984		4		
8	,,		,,	,,	,,	,,	2 3½	1985		in line		
9	,,		,,	,,	,,	,,	2 1½	2000		—	2	
10	,,		,,	,,	,,	,,	2 1	2010		2	—	
11	,,		,,	,,	,,	,,	4 10¾	2010		1	—	
12	,,		,,	,,	,,	,,	4 10			—	7	
13	,,		,,	,,	,,	,,	4 4	2000		1	—	
14	,,		,,	,,	6½°	,,	2 6	3400	not observed.			

(Signed) A. Vandeleur,
Woolwich, May 26, 1856. Captain R.A., and Capt. Inst. R.G.F.

Before concluding I must beg to lay before the section the results of a few experiments with regard to the crystallisation of large masses of iron by long-continued heating. It was asserted that iron, by long exposure to great heat, became crystalline in form and weaker than cast-iron, and that it was impossible to manufacture large masses of wrought-iron without producing this result. A well-known civil engineer went further, and, in conversation, expressed his opinion that iron, by long heating in the reverbatory furnace, absorbed carbon from the grate, and became cast-iron again. To prove the matter, I detached a portion of iron from an exposed corner of a large forging—in fact, a piece of burnt iron, and exactly similar to the samples I now produce—and the appearance, as you will observe, is entirely crystalline. This was pronounced by my friend to be really cast-iron. I proposed to work it by means of the smith's fire, and we found that, besides working under the hammer very well, it produced, when elongated by forging, an excellent fibrous iron, perfectly identical with the iron from which it was originally made. From this, I beg leave respectfully to maintain that, however iron may be crystallised by exposure to heat (or carelessly burnt, which is the same thing), its fibre may be restored by working either under the hammer or in the rolls.

I believe that all iron is crystalline in its structure, and that the difference is only in the size of those crystals; for the most fibrous, silky iron, if broken suddenly and by great force, breaks crystalline, but with a very fine crystal; and it was from this cause that the Ordnance Department hastily pronounced that wrought-iron became crystalline from long-continued heating, when the crystallisation was produced, more probably from the sudden disruption of the iron by the enormous explosive power of gunpowder.

Another means by which wrought-iron may be made crystalline is by slight percussive action, and this has been often discussed before this section, as also the means whereby the fibre is restored. There is yet another reason why sometimes large forgings fail, and are found unsound; I refer to uneven contraction of the heated iron. Since making the large gun, I have had to make two chamber pieces for the large mortars designed by Mr. Mallet, of Dublin, and found considerable difficulty, not from crystallisation of the iron, but from the peculiar shape of the forging. After making three forgings, each of which turned out defective, I began to consider the reason, and came to the conclusion that it arose from parts of the forging being of suddenly different dimensions; the smaller portions becoming cool first contracted, and the larger portion being restrained by the smaller (which was already fixed and unalterable) from shrinking, necessarily caused a contraction, which produced fissures in the forging.

EXTRACT FROM A PAPER DESCRIBING THE ROUTE BETWEEN KUSTENJEH AND THE DANUBE, BY THE KARA'SU AND YENI KENI VALLEYS.

WITH OBSERVATIONS ON THE NAVIGATION OF THE KARA'SU LAKES, AND THEIR ORIGIN; ALSO ON THE REQUIREMENTS NECESSARY TO RENDER THE WATER AND LAND COMMUNICATION PRACTICABLE.

By Capt. Spratt, R.N., C.B., of H.M.S. Spitfire.

This paper was read before Section E, on Friday, August 8th, 1856, and although it possesses no particular merit in an engineering point of view, it has been thought desirable to give the following extract from it, we having, on previous occasions, directed the attention of our readers to the importance of improving the navigation of the river Danube, and thereby opening out the resources of the contiguous corn-producing countries, and as the object sought to be attained by the proposed plan was to bring the produce from the Upper Danube directly south, and independently of Russian or Austrian interference, to which the trade of the Danube is subjected, in its course to the Black Sea.

The course of the main channel of the Danube, lying as it does from Galatz nearly due north and south as far as Rasovatz, whence it turns off to the west by Silistria and Rustchuk to Widen, and forming the boundary between Bulgaria and Wallachia, it will be seen that the course of the route is a short cut from the north and south piece of the Danube to the Black Sea coast. Capt. Spratt says:—"The Kara'su Lakes are the backwater only, and formed by the rise and fall of the Danube; they have no stream or spring as a tributary in any part. They could be made navigable for a distance of ten or twelve miles, so as to reduce the intervening land-carriage to Kustenjeh to a distance of about twenty-three miles, by merely shutting in the waters of these lakes when at their highest level, which would be when about 16 ft. to 20 ft. deep. The plan recommended is, that one-third of the Isthmus should, by a cut, be made navigable for barges, and a railway be made to traverse the remaining twenty-two or twenty-three miles, or it might be well to commence the railway at Chernavoda."

This railway would require no deep cutting, because it might be carried on to the level of the broad steppe, or flat down, which intervenes between the Kara'su valley and Kustenjeh, and thence on to the latter place, at the level of the cliffs and steep bank over the north-west shore of the bay or anchorage, where it would terminate at the station at an elevation of 130 ft. to 150 ft. above the sea.

He proposes that advantage should be taken of gravity thus offered for the transmission of grain at once from the trains, by means of shoots, into suitable stores erected beneath, or into ships or lighters, the necessary depth being dredged out for the purpose.

He suggests that a stationary engine should be erected to raise the imported goods, and he also points out other mechanical contrivances which might be advantageously employed.

A breakwater would be necessary, at first on a small scale only, and to extend from the point, so as to enclose a small sheet of water as a mercantile harbour, and capable of extension outward at any future time, for the purpose of forming a naval station.

The produce from Galatz and Ibrail might thus be brought to Kustenjeh, and the local advantages of the place would rival Varna as a naval and mercantile depôt.

The inner harbour should hold from 200 to 300 vessels, and if dredged out, which might be readily done, 5 ft. to 6 ft. more of water might easily be got.

Capt. Spratt proposes a scheme for avoiding transshipment of cargoes at the Danube terminus of the line, or at Chernavoda, as he considers that, for the short distance between Kustenjeh and the Danube, the barges, with their cargoes on board, might easily be drawn up a patent slip built on a suitable site at Chernavoda, and put in suitable wheeled cradles or trucks, and thus be transported to Kustenjeh at slow speeds, say four to six miles per hour, with sixty to seventy tons in each, or requiring only eight to ten hours for the journey, and thus being able to make two trips or journeys in the day.

A scheme is also described for bringing fresh water from the Prallas lake to Kustenjeh, where it is much wanted, and where, for the purposes of shipping, it would find an enormous sale.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

At the conclusion of the late meeting of the Association at Cheltenham, the following recommendations were made and adopted :—

Involving Grants of Money.

	£	s.
At the disposal of the Council for Maintenance of the Observatory at Kew	£350	0
To Mr. Osler, to complete his reductions of Anemometrical Observations	20	0
For a Report on the Chemical Nature of the Image formed in Photographic Processes	10	0
For a Report on the Compounds of Platinum and the Allied Metals with Ammonia	10	0
For Investigations on Earthquake Waves	50	0
For Completion of Table of Strata in the British Islands	15	0
For Experiments on the Temperature of Deep Mines in Cornwall	10	0
For a Report on the British Annelida	25	0
For Dredging Experiments on the Coast of Ireland	10	0
For a Report on Dredging the West Coast of Scotland	25	0
For a Report on Vegetable Imports of Liverpool	10	0
For a Report on Vegetable Imports of Glasgow	10	0
Completion of Report on the Typical Forms of Groups as the basis of Museum Arrangements	10	0
For Observations on the Growth of Salmon	10	0
For Completion for Publication of Rev. P. Carpenter's Report on the Mollusca of California	10	0
To Madame Pfeiffer, for Researches in the Natural History of Madagascar	20	0
To Mr. G. Rennie, for Experiments on Heat developed by Motion in Fluids	20	0
For Investigations of Life Boats and Fishing Boats	5	0
	£620	0

That copies of the Reports of the Parliamentary Committee for 1854-5, and 1855-6, be transmitted to each Member of the General Committee, with a request that opinions may be expressed as to the important subject, "Whether any measures could be adopted by the Government or Parliament that would improve the position of Science and its Cultivation," and that such opinions be forwarded for the consideration of the Council before the 20th of September.

That Mr. Cayley be requested to complete his Report on Theoretical Dynamics.

That an application be made to Government, by the Council of the Association, for an Expedition to complete our knowledge of the Tides.

That the application which was made to Government in September, 1852, concerning the Great Gentham Telescope, be renewed by the Council.

Section A.—That General Sabine, Professor Phillips, Sir J. C. Ross, R. W. Fox, Esq., and Rev. Dr. Lloyd, be requested to repeat the Magnetic Survey of the British Islands.

That Dr. Booth's Memoirs on the Geometrical Origin of Logarithms, be printed entire in the Reports, &c.

Section B.—That Dr. Miller be requested to report on Electro-Chemistry; and Dr. Price on Commercial Varieties of Iron.

Section C.—That the communication of Dr. Wright on the Echinoderms of the Oolite, be printed entire in the Transactions of the British Association.

That Mr. Etheridge's List of the Fossils from the Lias Bone Bed be printed in the Transactions of the Association.

Section D.—That Professor Buckman and Professor Voelcker be requested to continue their researches into the effects of External Agents on the growth of Plants.

Section E.—That a deputation be named to wait upon her Majesty's Secretary for Foreign Affairs, to urge the desirableness of sending out an Annual Expedition to the Niger, at the period of the rising of the waters of that river (which has been proved to be the most healthy season), as proposed by Dr. Baikie, supported by the Royal Geographical Society, and advocated by persons deeply interested in establishing a regular commercial intercourse with the inhabitants of that portion of Africa.

Section F.—That a memorial be presented to the Admiralty, praying for the complete publication, in a minute form, of the results of the trials of her Majesty's Steamships.

Section G.—That Mr. Rennie be requested to prosecute his experiments on the Velocity of the Screw-propeller.

That the Earl of Harrowby, Lord Stanley, Mr. J. Heywood, Mr. T. Webster, and other gentlemen, be requested to continue their efforts for amending the Patent System of this country, so that the funds arising may be available to the reward of meritorious inventors.

That Mr. Henderson, Mr. Russell, Mr. Atherton, and others, be requested to consider the best mode of improving the System of Measurement for Tonnage of Ships, and the estimation of the power of Steam-engines.

Mr. Fairbairn was requested to complete his reports on Boiler Explosions; Mr. Thompson, his report on the Measurement of Water, by weir-boards; and these two gentlemen to concur in experiments on the friction of discs in water and on centrifugal pumps.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(FROM OUR OWN CORRESPONDENT.)

Southampton, September 22, 1856.

The two iron screw steam-ships *Le Jacquard* and *l'Arago*, belonging to the Franco-American Company, and built at Nantes, have been here lately for docking purposes. Unfortunately for the French Steam Company's sailing from Havre, there is not at present in that port a single dry dock of sufficient capacity for first-class steamers, so that every nine or ten months the vessels of this Company must necessarily come here or to some other English port where graving docks exist.

The machinery of *Le Jacquard* and *l'Arago* presents many points of interest to engineers—especially to English engineers—as they are constructed for the use of the combined vapours of ether and steam, on the system of Du Tremblay.

They are by M. Cavé, of Paris, and are well finished and substantial-looking engines, precisely similar in each vessel. The *Jacquard* was the first afloat, and made several passages from Marseilles to the Crimea in the French Transport service, using ether steam in combination with ordinary steam. The causes of the abandonment of the ether we will proceed, further on, to explain; at present we will merely remark that for some months past she has been running with ordinary steam only, and that the *Arago*, which was launched some time after the *Jacquard*, has never used the ether at all.

The machinery consists of three direct-acting engines, having inverted cylinders, and with two piston-rods to each, which pass downwards below the crank-shaft to a common crosshead with guides; a short connecting rod returns the motion to the cranks, so that this engine is almost precisely similar in principle to those of the *Amphion* class, but vertical and inverted.

There are four double-beat valves to each cylinder, which are worked by cams fixed on two horizontal revolving shafts. The cams for the steam valves are conical, and slide on long feathers, so that the expansion can be varied from 1-10th of the stroke to almost full steam.

The motion for these revolving shafts is very simple and ingenious, and entirely dispenses with toothed wheels.

The cam shafts are placed on the port and starboard sides of cylinders, and about midway from their tops and bottoms. Their forward ends project sufficiently from the cylinders to allow of a short crank being keyed to them; from the pins of each of these cranks a rod proceeds to an eccentric on that part of the crank shaft projecting beyond the bearing. The crank pins mentioned are also connected directly together by a straight link, so that a rotary movement of the two cam shafts is obtained from the combined motion of the two eccentrics (which are, of course, of the same throw as the cranks), and of the connecting link which passes the cranks over their centres, somewhat like the coupled locomotive engines for goods' trains.

The two small air-pumps are worked by an overhanging crank from forward end of crank shaft: they, with the feed and bilge pumps, are below the platform of engines—in fact, almost in the bilge, and are complicated and inaccessible.

The ether "vaporiser" is placed on the starboard side of engine-room, and consists of a strong cast-iron chamber, with some 8,000 or 10,000 brass tubes inside it. These tubes are flattened to save space, and measure inside about $\frac{7}{8} \times \frac{5}{16}$; they are each about 4 ft. long. The condenser consists of a similar apparatus to the vaporiser, and is placed on the opposite or port side of engine-room.

We must now state that the two forward cylinders formed the ether engines—that is, that they were worked entirely by the elastic force of ether steam, and that the after cylinder, which is of rather larger diameter than the other two, is an ordinary steam-engine, and supplied direct from the boilers with steam of about 30 to 35 lbs. per sq. in.

The action was as follows:—The exhaust steam from the after engine passed into the vaporiser, and by coming in contact with the outside surface of the tubes mentioned, which contained ether, was itself condensed into fresh water, which was pumped back into the boilers. The heat of the exhaust steam so imparted to the ether contained in the tubes was sufficient to boil the ether, and convert it into vapour of high elastic force, which passed by proper pipes into the two ether cylinders, and after giving motion to their pistons, is exhausted through the inside of the tubes of the "condenser."

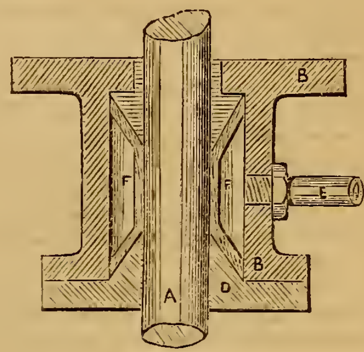
The exterior of these tubes being surrounded by a constant current of cold sea water, condensed the ether vapour, and re-converted it into liquid ether, which was pumped back into the vaporiser.

So that, *theoretically*, they obtained the force of two cylinders without a corresponding consumption of fuel, and had fresh water only in the boiler.

This beautiful application of scientific principles must reflect the highest honour on its inventor, M. du Tremblay; and if it has not been successful in these two vessels, it is possible that further improvements may be made, which will obviate the difficulties which have been here experienced, and which have led to its abandonment; of these we shall now proceed to treat.

The vapour of ether is extraordinarily subtile in its nature; ordinary engineering contrivances of stuffing-boxes and joints do not suffice to confine it, and the French engineers who have experimented upon it have displayed much ingenuity in attempting to overcome these difficulties. They have found that the joints must be perfect surfaces, with bolts and nuts very close together, and in place of red lead, paint, and canvas—which we usually employ—paper soaked in a solution of gum arabic. We understand that, with these appliances properly carried out, they succeed in obtaining really tight joints.

But the stuffing-boxes are the (at present) weak points, and it is from them that the greatest loss of ether is sustained. They are made on the principle of the cupped leather packing of the common hydraulic press. In this case the pressure behind the packing is sustained by a small pump worked by the engine, which conveys oil or water through a small pipe to each gland, under a pressure which can be varied by a loaded valve, to insure tightness.



A, is a piston or slide rod.

B, part of cylinder or slide jacket gland.

C, conical bush.

D, gland, which is strongly bolted and jointed to B.

E, oil, or water pipe, for keeping a constant pressure on back of packing.

F, the packing, which is a sheet of *moleskin*, lapped round the rod, and kept there by being tightly bound with string.

Notwithstanding these ingenious contrivances the loss of ether from various sources, but, as we have before stated, chiefly from the stuffing-boxes, averaged in the *Jacquard* from 50 to 150 litres a day. And as ether costs in France about 3 fr. per litre, this gives a loss of from £6 to £18 a day to set against the saving of fuel. We understand from her engineers that on the commencement of a voyage the loss was comparatively small, but that after a few days' run, when the packings had become worn, and consequently leaky, the loss increased; so that on the average of a voyage from Marseilles to the Crimea it was as above mentioned. A great deal of this may no doubt be attributed to the number of stuffing-boxes which these engines have; viz., two piston rods and four steam valves to each engine, making in all eighteen stuffing-boxes to keep tight, whereas in the ordinary engine with two cylinders, each with one piston rod and one slide valve, there would be only four stuffing-boxes to keep tight.

We need hardly mention that the vapour of ether is inflammable, and therefore when it is used great precautions are necessary to prevent accidents. The engine-room is separated from the stoke-hole by a close bulkhead, and is well ventilated by air pipes from the deck.

The lamps used by the engineers are similar in principle to Sir Humphrey Davy's miner's lamp, and we are informed by the engineers that no accident has at any time taken place in the *Jacquard* from the use of ether.

The advantage gained by its use would have been considerable had it not been from the loss by leakages, as the revolutions of engines, when ether was used, were from 40 to 45 per min.; and at present, when using steam only in two cylinders, viz., the forward and after one (leaving the middle cylinder disconnected), the revolutions are only from 32 to 33 per minute. The consumption of fuel was the same in both cases, viz., about eighteen tons per day. Taking the mean revolutions as 44 and 33, and the resistance of the vessel being as the square of its velocity, we have $\frac{44^2}{33^2} = \frac{1936}{1089}$, so that the power given out by the engines with the ether was nearly double that with steam only, and with the same consumption of fuel. This is a striking *fact*, and may be depended on; and although we are sorry we cannot at present give our readers the exact result, owing to our want of indicator diagrams, which alone could show the precise difference, still the effect, as expressed by actual revolutions of engines, is a very *practical* datum for estimating the advantage realised. We must return to this subject next month, but will conclude at present with their principal dimensions.

Vessels built at Nantes, barque rig, square stern, can carry very large cargo.

	Ft.	In.
Length on deck	250	0
Do. on keel	230	0
Breadth moulded	36	6
Depth	23	0
Tonnage (French)	933	
Drain of two ether cylinders	0	55
Do. of steam cylinder	0	63
Stroke of all three cylinders	0	35½

Four-blade screw 17 ft. 7 in. diameter × 27·6 pitch.

N.B. Four-blade screws are in much favour with our allies, who think them better than any other.

The Peninsular and Oriental Company's new screw steam-ship *Aden*, launched from the building yard of Messrs. Summers and Day, of Northam, has lately returned from her first voyage to the Peninsula, having accomplished the voyage in the shortest time recorded. Her route lay from Southampton to Vigo, Oporto, Lisbon, Cadiz and Gibraltar, a distance of 1,250 knots. Her outward voyage was accomplished under way in 110 hours 15 min., giving a mean speed of 11·36 knots or 13·25 statute miles per hour, and her homeward voyage in 119 hours 20 min., giving a mean speed of 10·48 knots or 12·22 statute miles per hour. The homeward voyage was lengthened some three or four hours, by going slow from Gibraltar to Cadiz in the night, in order not to arrive at the latter port before daybreak.

The fore and aft sails with which she is rigged, were of little service to her throughout the voyage, as she experienced chiefly head winds.

The consumption of coal, per indicator, amounted to 3·6lbs. per H.P. per hour. The mean indicated H.P. throughout the voyage was 700. On a trial of this vessel in Stokes Bay, 23rd ult., by the Government surveyors, a mean of four runs, at the measured mile, gave a speed of 12·519 knots or 14·6 statute miles per hour.

The vessel was deeply laden in accordance with the requirements of the Admiralty, having on board 425 tons of coal.

Water, &c., draught forward	13 ft. 5 in.
„ ditto aft	14 ft. 3 in.
Displacement	1,205 tons.
Immersed midship section	302 sq. ft.
Mean indicated H.P. of four runs	900
Co-efficient of immersed midship section	657
Ditto of displacement	246

The Captain of the *Aden* during her late voyage, reports that with the strongest wind a-head which they experienced, they never got less than 9·6 knots per hour, which may be considered a very good speed, and help to refute the ordinary opinion of sailors, that screws cannot compete with paddles, "head to wind."

THE LATE FIRM OF J. S. RUSSELL AND CO., MILL WALL WORKS.

The formation of Joint Stock Companies seems to be the order of the day, and whilst we see old Companies, and, now-a-day, even London Joint-Stock Banks, smashing up and turning out to be mere bubbles and swindles, new companies start into existence like mushrooms, to do all kinds of things, and, for which private capital, judiciously expended under competent direction, would suffice, and give more profitable results than when worked by the expensive and often too ponderous machinery of a joint-stock company.

There are, however, many operations properly the matters for being worked by joint stock arrangements, and amongst them none offer greater advantages than in the building of ships. Here a large capital is necessary, and a large and expensive establishment indispensable to the carrying on profitably of such works.

We learn that a project is on foot for purchasing the business, premises, plant, machinery, tools, &c., from Mr. Russell's trustees, and forming a limited joint stock company, with shares of small amount, to work the concern.

We are told that Mr. Ditchburn, who was the first builder of iron vessels on the Thames, and who founded the once-flourishing iron shipbuilding concern of Ditchburn and Mare, Blackwall, is to have the management of the new company's ship yard; this we consider to be a highly favourable feature in the undertaking, and if the managers of the new compauy are desirous of securing as large an amount of success as possible, they will *not* undertake the making of marine engines, but confine themselves to the building of iron ships, and the repairs of machinery, &c., leaving the construction of new marine engines to those who should be (and would then be) their customers and best friends—the great marine engineers of this country.

CORRESPONDENCE.

THE CAUSE OF AND REMEDY FOR THE UNPROFITABLE STATE OF SHIPBUILDING.

PRACTICAL IMPROVEMENTS.

To the Editor of *The Artizan.*

Sir,—What a series of contradictions to the universally-adopted maxim, that work can be better executed by machinery than by manual labour, does the present practice of shipbuilding offer to our consideration! Can it be possible that what is proved to be best in other mechanical arts, will not hold good in shipbuilding or is it to be inferred that the rest of the mechanical world can be in the wrong, and that shipbuilding is the only art that is right? It certainly is a question of the greatest importance; and, with your permission, I will endeavour to state, in a popular manner, what is the present practice of shipbuilding, and in detail on each separate part, compare it in connection with the suggestions of the August Number, namely, the application of machinery, the division of labour, a properly constructed yard, and other appliances which I consider necessary to a profitable system of shipbuildiug, and at the same time point out in succession what improvements are required upon each separate process, as the best means of illustrating the advantages to be derived from such suggestions.

With this object, magnitude of operations is of the utmost importance: and in a properly constructed yard the saw-mill must stand in the centre, with three or four building slips on each side, and in immediate contiguity; and the appliances ought to be on such a scale as to complete four vessels under each slip in one year, and the vessels to have a seven years' classification with respect to the material employed in their construction. A most important question arises, "What would be the pecuniary advantage if each slip were covered over with a substantial roof, according to Lloyds' regulations?" The vessels would have an additional year assigned to their character, and assuming that 3,000 tons were completed in one year under one roof, the value of each vessel, at the lowest calculation, would be increased 10s. per ton, or £1,500 per year,—a good return for a roof that would not cost £4,000; and again, assuming that various-sized vessels were building at the same time, the advantages from the better conversion of the material would give a return of five per cent. on the capital invested in the undertaking.

In proceeding with the details of shipbuilding, it will be necessary to assume that the vessel to be built is of 1,000 tons, so as to affix a value to each operation. And here it will be necessary to state, that the whole system of the present practice is of a mere temporary character, such as the making of the moulds, the forming of the blocks, the framing and building stages, and the launch, the expense of which in labour and material may safely be estimated at £200, which, if contrived for a permanent system and a more extensive and systematic application, would not cost one-third that sum for each vessel.

First, with respect to the keel, stem, apron, knight-heads, stern-post, keelson, beams, and other parts in the formation of a vessel (here commences those contradictions to the established maxim that work can be better executed by machinery than by manual labour), which, whether sawn by machinery or by manual labour, are, in practice, always cut larger than are required, so as to require trimming by the shipwright—it seems to be an established fact, that nothing can be made perfect in the first operation. I ask, can it be possible that the ingenuity of this country cannot erect a sawing-machine that will cut two parallel straight lines? The idea is preposterous. The principle of the requisite machinery is in daily operation in every engineering establishment in the kingdom. The primary object of these suggestions is to point out the great advantages in the saving of labour to be derived from each part being made perfect at the first operation.

Secondly, the system of framing adopted in shipbuilding demands the most serious consideration; and were it possible to point out a more absurd, erroneous, or barbarous method than at present practised, it would be necessary to go back to that period *when* mechanical construction and the application of materials for such purposes were in their infancy. Will it be credited that the present system is so erroneous, that the timbers, whether sawn by machinery or manual labour, are required to be cut five per cent. larger on an average than is necessary? so that the timbers are actually cut large enough for a vessel 200 tons larger than the one about to be built, merely to counteract the errors incident to the present system of laying off, and putting the frames together; and even then it is necessary to employ the most skilled labour. Then, again, after the timbers *are* trimmed and in their places, it actually requires 1-10th of the whole cost of trimming and putting the frames together to rectify them on the outside, and a further 1-8th of that cost to trim them off on the inside. Such is the system of framing that requires three distinct operations for the outside, and two for the inside. Is such a system tolerated in any other mechanical art? There are numerous constructions, equally complex where each part can be formed ready for its place at a single operation. Surely the ingenuity of the nineteenth century can produce such a system in the building of a ship as was employed in the building of a temple 3,000 years ago!

In proposing a better system for the putting the frames together, it will be necessary to point out what is the method that produces such inaccurate results, as it is of indispensable importance that the most perfect accuracy in the framing is requisite to produce those improvements, upon which the whole superstructure of these suggestions is founded.

First, the system is theoretically wrong, because the timbers are not in that line for which they have been laid off and trimmed for—in many parts the timbers being six inches off each other, or three inches on each side of the supposed line they were laid off for and cannot practically be right; consequently, the three operations previously mentioned must be performed to rectify them on the outside. The remedy is obvious: place the timbers in that line for which they are laid off; consequently, it will be necessary to have two lines in each frame, dividing the room and space equally, and placing the moulding edges of the timbers to those lines. The effect would be, that the space between the timbers would be more regular than in the present system. And here, again, it will be necessary to state that the moulds, the stage or platform for putting the frames together, and the getting them up in their places, are entirely of a temporary character. Now, considering that the labour in the framing of a vessel amounts to one-half the whole cost, a permanent system would be of the greatest advantage in economising labour and material.

Secondly, in carrying out these suggestions, the question arises, "Is it possible to have the timbers cut by machinery perfectly correct in a single operation?" I assert that it can; but then it will be necessary to remove the temporary character of the moulds, by substituting single moulds for each timber, which would create a great saving of time to the converter, and if the bevels had a name (say a number of degrees) the consequence would be that that number could be expressed upon the machine, instead of the system in use, with Hamilton's Patent. The simple process of giving the bevels a name, would increase the productive power of that patent 100 per cent.; and again, by making the bevelling spots at an equal distance from each other, the ingenuity of this age would soon make those machines self-acting; for, giving the required variation in the bevels, this process would create a saving of one man's labour in the use of those machines, and which can be the only means of producing the desiderata of having the timbers cut perfectly correct at a single operation; but then again, by means of the form previously suggested, where 4-5ths of the timbers are perfectly square, and of the same form, combined with a division of machinery, for each process in sawing the timbers, it would be of the utmost importance; a saw-frame must be made solely adapted for siding, another for square timbers, and another for cant timbers; even then there must be another subdivision for large and small scantling. Hamilton's sawing-machinery at present being adapted to cut from a 4-foot keelpiece down to a 3-inch deck, and either straight or circumlinear, such machinery cannot be the most economical. The advantages of such a system of division would fully bear out my assertion of making machinery 300 per cent. more profitable than that which is in present operation.

Thirdly, would it not be better to have a permanent platform at the head of each vessel for the framing, instead of the present temporary stages, and blocking up, which is required for each frame, with a traversing crane over the slip to place the frames in their situation? It will be here necessary to point out that in some shipbuilding establishments there are tram-roads, to convey the material from the saw-mill; but then it only drops the material at a distance from the head of the vessel, still requiring manual labour to convey it to the stages. For any practically useful purpose, the material might, as cheaply as in the first place, have been carried from the saw-mill, with the system of a permanent platform, the tram-road could be carried through the centres of the platforms, dropping the timbers nearly in these places upon it, the traversing crane lifting the whole frame at a single operation across the keel. With this system for the conveyance of material, the use of labourers would be rendered almost unnecessary in this part of shipbuilding, where they are most used. The advantages of the platform in a mechanical point of view, would give the most perfect accuracy in the formation of the frames, in connection with the system of laying off previously proposed; the correctness of the framing would be acquired by having the body plan transferred to the platform; it would then be only necessary to square up the edges of the frame from the lines on the platform. The process would be of such simplicity that mediocrity of talent would be all that is required, instead of the most skilled labour as in the present operation; and then again by having the upper part of the platform raised to suit the various sidings of the timbers, compared with the temporary blocking up, as at present required for each frame, it would give such rapidity to the operation, that the labour required would be scarcely a tithe of what it is at present. With such an accurate system of framing, it is quite possible to make the moulds so perfect, that the ends of the timbers might be cut off and dowelled by machinery in the saw-mill, only requiring to be bolted together.

If the advantages of this system are such as have been attempted to be proved, the advantages offered for the further application of machinery to the boring of the treenail holes is apparent, more especially by having four-fifths of the planking of the same breadth; the consequence would be that the timbers, by having the holes bored in them, would be more perfectly examined with respect to their defects, and better seasoned in the same time.

The next operation, the ribbanding and harpening, is again completely a temporary system of keeping the frames in their places to receive the planking, but which cannot be avoided with the present inaccurate system of framing. And here it becomes evident, that the perfect accuracy of framing is of the utmost importance in developing those improvements which are necessary for further reducing the amount of labour in the construction of wooden vessels. Granting that the frames can be made perfect, the advantage would be, that the ribbanding of the square body could be completely effected by the permanent planking itself. Now, admitting that the labour and material in the ribbanding and harpening amounts to £100 (which is a low calculation), and that the harpens are scarcely ever used upon two vessels, from the non-expansive form of the present vessels, or from not building a succession of the same sized vessels,—now, with an expansive form, or a succession of the same formed vessels, permanent iron harpens, made of angle iron, would be the cheapest, and the effect would be that with the square body ribbanded by the planking, the saving thereon would be fully 75 per cent.

The outside and inside planking next demand our consideration—an item in the construction of vessels next in importance to the framing in the amount of labour required; and, however painful the confession, a single alteration has not been made in the system for the last 25 years. Let me compare the system with a stone or brick construction: first, the shipwright takes the required account and bevels, say of two planks, goes to the plank stock and trims the two planks to the form required, places them in the steam-kiln, comes back on to the vessel, secures the planks previously wrought, sees that the timbers are correct, and gets ready the material for working the two planks, goes and brings them on to the stage, and bends them with the same appliances as might have been in use at the building of the *Great Harry*. With such a system can we wonder that the amount paid for labour in shipbuilding does not decrease, as it does in every other mechanical art? Does such a system apply to a brick or stone construction? What an absurdity it would appear to have the bricklayer mix his own mortar, carry his own bricks, place them in their situation, and then repeat the operation; or a stonemason first dress the stone, mix the mortar, and then place the stone in its proper position! Such a system would never have answered in the building of the brick arches of our metropolitan railways, where the greatest part of the work was done by the unskilled labourer, only requiring the bricklayer to point the work on the outside. The operation was so contrived that the number of labourers were so adjusted in placing the exact quantity of mortar proportionate to a number of bricks in their place, that the system had the appearance of well-regulated machinery, that the instant one workman did not support his allotted part, the whole was brought to a standstill, and, at the same time, pointing out the deficient workman. Such a process is the desiderata required in the planking of a vessel—and in the whole of shipbuilding. To effect such an object the importance of having four-fifths of the planking the same form becomes apparent. By means of such a form an ordinary moulding, combined with a planing machine, would manufacture that amount of planking, perfect and of unrivalled excellence, complete for the sides of the vessel, and at a tithe of the cost of the present system; and here, again, it is necessary to add that the adze or axe, the use of which is the most difficult to acquire, would be completely dispensed with. With the planking so prepared, the shipwright need scarcely leave the side of the vessel, which would be the means of introducing the division of labour so requisite in the planking. In America, our greatest rival in shipbuilding, the system is being carried out by having workmen to bring on the planking, bore the holes, drive the treenails or bolts, and so on.

The next consideration with respect to the planking is—Are the appliances used in the bending of the planks the most perfect for that purpose? the same having been in use for the last century, although the fact of their use for such a length of time is no proof that they are the most economical; the wedge in connexion with ringbolts and staffs being the chief agent in the present system, but which at the best is a most clumsy arrangement. Nippers or cramps are most useful contrivances, but then they are only available when the plank is not worked on one side of the timber. A better plan, which would require no great stretch of ingenuity, would be to combine the screw with a sliding bar and bolts in the open treenail holes, and it would be a more powerful machine, besides being more economical in the consumption of wedges. Then, again, there would be the standards for the traversing crane and roof, which would have to be very substantial, and which would be a great assistance for fixing the plank in midships where no very great strain was required. It is proposed that these standards be so secured that the vessels shall be completely shored from them, and, it may be added, that they would be a great assistance by their strength in ribbanding the vessels, the whole forming a permanent framework of the utmost importance in relation to the minor details of the construction of vessels, and in economising labour instead of the present temporary system.

It is scarcely necessary to enter into any further detail of the other parts of a vessel, as sufficient of the system pursued has been described, accompanied by such suggestions for their improvement as are requisite to illustrate my object; it being only necessary to add, that they all bear the same ratio with reference to improvement as those parts which have been here but imperfectly attempted to be described. But when these mechanical improvements for reducing the necessary skill of the workmen are further assisted by the division of labour, these suggestions become of the most lucrative character, and would fully bear out my assertion of creating a saving of 70 per cent. in the item of labour. Then, again, the important feature in the form proposed of having four-fifths of the timber the same form, a great portion could be made of the form and size required on the spot where it is produced; consequently saving a vast amount of waste freight and duty.

Such are the improvements necessary to produce a profitable state of shipbuilding, and which are indispensable to this country for the purpose of enabling it to compete with our foreign rivals in low-classed vessels. The present system cannot be maintained longer with advantage to this country: and means must be found to keep the mere adventurer or man of straw from undertaking the building of vessels, for the science of naval architecture will never be properly established until shipbuilding can be made permanently profitable on a large scale, while such men are continually taking advantage when ships are dear in overrunning the shipping trade, to the injury of the legitimate and scientific builder, with vessels that neither promote the science nor are essential to the pecuniary interest of the shipowner. As a means of producing such an important object, I still assert that shipbuilding on a large scale is the only method of bringing the science of naval architecture, and the perfect construction of vessels, to perfection. "It is not the experience of one man, nor of one generation, but of all mankind, in all ages, registered in books, and recorded by tradition," that can produce such a desideratum. The ideas of our forefathers have been completely lost sight of in the formation of vessels, from the unprofitable nature of shipbuilding. A dozen vessels, the effort of a lifetime, are insufficient to establish the principles of their construction, or in retaining those views for further improvement, each beginner of shipbuilding having to commence anew, perhaps, those principles of which no record has been kept, and which may have been found by our predecessors not to answer.

A most important question arises, What has become of the experience of Chapman, Bouguer, Attwood, and other celebrities of the last century? Length of vessels for producing fast sailing is no new invention; for M. Bouguer, in his treatise, 1790, speaks of vessels sailing as fast as the wind, merely by increasing the length to six times the breadth. The sectional form adopted at that time, and still retained in the French and Spanish navies, in the *Canopus*, and other large vessels in the English navy, and in many foreign countries for their merchant service, as well as by many of our celebrated builders, is in this communication suggested as the best form for the application of machinery. The "why and the wherefore" of that sectional form for every useful purpose was explained by me in The Artizan, Vol. xi., p. 228, entitled, "Stability, and the Causes of a Vessel's Deviation from her Course."

To the shipowner and legitimate shipbuilder, the advantages of removing shipbuilding out of the reach of the speculator, and placing it in the hands of capitalists, is of primary importance, which can only be effected by means of extensive machinery, so as to put a stop to that temporary system of shipbuilding (for which £100 is amply sufficient for the requisite outlay) which only comes into periodical existence when vessels are saleable, as such a system could not compete with those appliances which have been here suggested; consequently, the shipbuilding trade being in the hands of capitalists, whose interest it would be only to supply the legitimate requirements of our shipping, and whose character would be a sufficient guarantee that the vessels were perfect in every respect, and thus preventing those serious fluctuations in the value of shipping which are so prejudicial to the legitimate shipowner.

In conclusion, let me point out to the enterprising capitalist of this country, what the effect of shipbuilding on a large scale would produce. Competition by the speculator would rapidly vanish. Naval architecture, in the formation and construction of vessels, would soon arrive at perfection. By the possession of patents for machinery, a monopoly of shipbuilding would soon be effected, and, in consequence, the enterprise of the British empire would soon be able to manufacture wood of foreign growth, as it has done other foreign materials for the whole world, where there is no prohibition to the introduction of the skilled results of British enterprise.

I am, Sir, yours truly,

R. Armstrong.

THE ARITHMETIC OF NAVAL ARCHITECTURE.

To the Editor of The Artizan.

Sir,—The importance of bringing the science of naval architecture, steamship capability, and steam transport economy within the pale of arithmetical calculation, cannot be over estimated. The endeavours of Messrs. Atherton and Napier, before the British Association, are a sufficient proof of its importance and its immediate necessity; it is the only means by which a foundation to the science can be established and on which the various characters of efficiency can be registered.

In the attempt to establish rules or formulæ for naval architecture, a standard or unit of resistances for every rate of sailing must be established; it is of the same importance to naval architecture as the 33,000 lbs. in the calculations of horse-power; but however indefinite the term horse-power may be, it must be retained as the unit in these calculations, and as indicated. If ever the term is discarded, the quantity of coal for each indicated horse-power (say four pounds) could be made the unit for propelling a vessel, and this would have an £ s. d. value.

I still adhere to the ratio of the resistance that a vessel encounters at every rate of sailing, for the standard as best adapted for testing each vessel on its own merits without using comparisons, which, together with the argument, appeared in vol. xi., pages 206 and 275 of The Artizan, and which it is now necessary to repeat, with the consumption of coal added—namely, it requires 100 lbs. of coal, or 25 I. H.P. for 100 sq. ft. of immersed midship section, to produce a speed of five miles per hour.

Coals.	I. H.P.	Mid. Sec.	
144	36	100	6 miles per hour.
196	49	100	7 "
256	64	100	8 "
324	81	100	9 "
400	100	100	10 "
484	121	100	11 "
576	144	100	12 "
676	169	100	13 "
784	196	100	14 "
900	225	100	15 "
1,024	256	100	16 "
1,156	289	100	17 "
1,296	324	100	18 "
1,444	361	100	19 "
1,600	400	100	20 "

This is my theory of the resistances; but whether perfectly correct, which experience will test, the ratio between the horse-power and the midship section must be retained. It will be the length of mile, or value of horse-power, that it will be necessary to alter; but if the unit of power for propelling is taken as the consumption of coal, a greater amount of indefiniteness will be saved.

As it was three years ago, the science of naval architecture is without a champion that will boldly avow what data in the construction of a steamship is required for any given rate, the power being given. Mr. Atherton's attempts in "showing that mercantile transport service by steamships admits of being brought within the range of arithmetical calculation, whereby the dynamic quality of ships, the size of ships as measured by displacement, the working quality of the engines, and engine-power, as measured by the unit indicated horse-power, and the speed to be assigned as the condition of any service, may each be treated as functions of calculation, involving definite pecuniary considerations, constituting a system which may be denominated the arithmetic of steamship adaptation to the requirements of mercantile service," is certainly an effort in the right direction, and however necessary such a desideratum as he described may be, the formula $\left(\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}} = C\right)$ is too rough an approximation to be of any practical use for the formation of a steamship, or as a test of any single part of a whole vessel.

The formula, founded on the proposed ratio, that will produce such a desideratum as Mr. Atherton has proposed, is as follows:—

$$V^2 \text{ miles} = \frac{\text{I.H.P.} \times 100}{\text{Mid. Sec.}}$$

$$\text{I.H.P.} = \frac{\text{Mid. Sec.} \times V^2}{100}$$

$$\text{Mid. Sec.} = \frac{\text{I.H.P.} \times 100}{V^2}$$

As illustrations for the application of these formulæ I will take one of the last new wood vessels of the Royal West India Mail Company, and the *Banshee*. The dimensions of the former being—

Length	270 feet.
Breadth	42 "
Depth	26 "
Builders' tonnage	2,250 "
Displacement at 19 feet	4,000 "
Area of immersed mid. sec. at 19 feet	680 "
Displacement per inch	24 tons.
Horse-power, No.	800 "

Banshee's Dimensions, &c.

	Ft.	in.
Length	189	0
Breadth	27	2
Depth	14	9
Builders' tonnage	670 tons.	
Horse-power, No.	350	
Displacement at 9 ft. mid. sec. ...	770 tons.	
Area of immersed mid. sec. at 9 ft.	190 sq. ft.	
Mean speed at trial	18·62 miles.	
Average between Holyhead and Dublin	15 do.	
Ditto Mediterranean	13 do.	

These examples may well be considered as a type of two most opposite vessels, and their rates of sailing are well adapted to test the truth of the above formulæ. Is it at all inconsistent with their performances that the *Banshee*, at the 9 ft. draft of water, required 660 Ind. H.P. to produce 18·62 miles per hour, or 427 Ind. H.P. for 15 miles; or in the Mediterranean, with one-half her boilers out, 321 Ind. H.P. for 13 miles per hour; whilst the former example, at the 19 ft. draft of water, the horse-power required to produce 12 miles per hour, was 980; at the 18 ft., the same rate, 918; and at the 17 ft. draft of water, 858 H.P.

I will now insert two tables—the first based on the West India Mail Company's steamship, the type of which is considered anything but first-rate; the other on the *Banshee*, the type of which is considered perfection. They exhibit at one view the conditions required for various rates of sailing, &c.; but not the extremes of Mr. Atherton's assumed vessels, A and B.

Such tables ought to be supplied by every builder to the owners of the steamship supplied, so as to enable the captain of the vessel to detect whether the vessel supplied in all its parts was doing its assigned duty, and to establish what is the correct ratio of the resistances at the various drafts of water and immersed midship sections; these tables indicating what data and facts are required to establish—the correct ratio of the resistances that a vessel encounters at every rate of sailing.

West India Mail Company's form of Vessel.

Displacement. Tons.	Draft of water.	Immersed Mid. Sec.	I. H.P. for miles per hour.			Consumption of coal per hour.		
			8	10	12	8	10	12
2500	14	470	300	470	676	1200	1880	2704
2840	15	512	327	512	737	1308	2048	2948
3136	16	554	354	554	797	1416	2216	3188
3424	17	596	381	596	858	1524	2384	3432
3712	18	638	408	638	918	1632	2552	3672
4000	19	680	435	680	980	1740	2720	3920
4288	20	722	462	722	1039	1848	2888	4156
4576	21	764	489	764	1100	1956	3056	4400

Banshee form of Vessel.

Draft of water.	Mid. Sec.	I.H.P. for 12 miles.	I. H.P. 13	I. H.P. 14	I. H.P. 15	I. H.P. 16	I. H.P. 17	I. H.P. 18	I. H.P. 19	I. H.P. 20
8	163	234	275	319	366	417	471	528	588	652
8½	176	253	297	345	396	450	508	570	635	704
9	190	273	321	372	427	486	549	615	685	760
9½	204	293	344	399	459	522	589	660	736	816
10	218	313	368	427	490	558	630	706	786	872

I will now endeavour to analyse by my formula the two vessels, A and B, suggested by Mr. Atherton, as a test of the trustworthiness of the formula $\frac{V^3 D^{\frac{2}{3}}}{\text{I.H.P}} = C$ as a measure of efficiency.

By means of that formula, each vessel being 2,500 tons load displacement, he deduces the following conditions:—The vessel A will be propelled, at 8 knots, 10 knots, and 12 knots per hour, by 376, 736, and 1,272 I. H.P: and the vessel B will require, to attain the same rate of speed, 568, 1,112, and 1,920 I. H.P.

By my formula for finding the immersed midship section, viz.—Mid. Sec. $= \frac{\text{I.H.P.} \times 100}{V^2}$, the vessel A having for those rates respectively 443, 556, and 667 sq. ft. of immersed midship section; and the vessel B 670, 840, and 1,008—these proportions of midship section to displacement proving that the formula $\frac{V^3 D^{\frac{2}{3}}}{\text{I.H.P.}} = C$ does not produce a constant midship section. But even on Mr. Atherton's own showing, I deny the existence of any vessels with such proportions of power, speed, displacement, &c., as assumed by Mr. Atherton, the vessel A having for the 12 knots, 2 tons displacement, for 1 I. H.P., and the vessel B 1·3 tons to 1 H.P.

Then, again, there must be some error in those calculations; the vessel A for 12 knots, weight of ship, 1,000 tons, H.P. 318 tons, coals, 615 tons, and cargo, 875 tons—total, 2,808 tons; and the vessel B, weight, 1,000 tons, H.P. 480 tons, cargo, 556 tons, and coal, 929 tons—total, 2,965 tons. The assumed displacement being 2,500 tons, it appears as if the weight of the engine had been overlooked.

With such errors in data from those assumed co-efficients, and in the calculations on which Mr. Atherton deduces his pecuniary charges, I will not attempt to follow, but proceed with such calculations on my own formula, taking as a basis five tons of displacement for each horse-power as the best method of comparing the efficiency of vessels, the consumption of coal at 4 lbs. per indicated horse-power, and Mr. Atherton's expenses of the vessel at 8d. per ton per day, and the engine at 9d. per day per horse. Therefore, taking 2,500 tons displacement, and 500 H.P. for each vessel, as the first illustration, the midship sections to produce eight and twelve miles per hour, would be respectively 781 and 347; the consumption of coal for 100 miles being 25,000 lbs., and 16,666 lbs., or a saving of 50 per cent. in the consumption of coal, and the expenses for tonnage and power £53 and £35, which are in the same proportion, with an additional quantity of cargo equal to the difference in the quantity of coal required.

This illustration shows that an increase of 50 per cent. in speed, with a reduction of 50 per cent. in the expenses, may be obtained by reducing the midship section with the same power.

For the second illustration, the same displacement, but with 470 ft. of midship section, the rate of eight miles and twelve miles would require respectively 300 and 676 H.P.; the consumption of coal for 100 miles being 15,000 lbs. and 22,500 lbs., and the expenses of vessel and engine £49 and £37, a saving of £12 at the twelve-mile rate of sailing, a saving amply sufficient to purchase, in any part of the world, the extra three tons of coal required. This illustration shows that by the *same midship section*, an increase in the rate of speed of 50 per cent. is not of that expensive nature so universally supposed.

For that fabulous rate of sailing twenty miles per hour—as a last illustration of what conditions are required for that speed—I must take the *Banshee*, and for the sake of argument I will admit her water-lines are perfect, and by the table on the *Banshee*, at 10 ft. water, the midship section and power would be respectively 218 and 872; at the 9 ft., 190 and 760, and at the 8 ft. water, 163 and 652; four times the area of the midship section in feet for the number of horse power, is the only condition how such a coveted speed can be obtained. If a form of water-line could have produced such a desideratum, it would have been an accomplished fact by this time. Can there be a question that in designing such a vessel, the amount of displacement is of the utmost consequence in every arrangement? for instance, the three different horse-powers mentioned, produce twenty miles an hour in the same vessel; but can there be a doubt that the twenty miles per hour could be more economically gained at the 8 ft. draft of water, having 220 H.P. less to provide for than at the 10 ft.? Again, at her trials, when the rate was 18·62 miles at the 9 ft. water, the horse-power being 660, the twenty mile rate might have been gained with the same power, if the vessel had been lengthened to give the necessary displacement at the 8 ft. draft of water; or it might have been suggested that 100 additional horse-power, with perhaps fewer lines, would have produced that desideratum; but from not making provision for the additional weight of engine and coals, the vessel would have had a greater draft of water, consequently a greater midship section, and all the expected advantages to be derived from the increased power, are completely lost, when taken into account with the accompanying expenses; this illustration proving that where the resistance increases as the square of the velocity, BY REDUCING THE MIDSHIP SECTION, THE RESISTANCE DECREASES IN THE SAME PROPORTION.

In summing up the advantages of bringing the science of Naval Architecture within the range of arithmetical calculation, it will be the means of ascertaining what the locomotive duty of marine engines is, under various conditions, and expressing that duty in £ s. d. It will be the means of calculating the tons of displacement carried by one horse-power, at any rate with the cost (the best comparative value of steamships); and above all, it will be the means of placing the science of Naval Architecture in a position to point out the errors of steamship construction; to the captain of the vessel, the advantage of ascertaining whether the engine is doing its proper duty; and to the steamship proprietor, the prevention of those disappointments which have been of such frequent occurrence.

In conclusion, whatever may be the difference of opinion amongst naval architects with respect to the best form of water-line, the conclusions used in this communication are founded upon one universally adopted principle,—that a vessel cannot be propelled at the same rate, when deep loaded, as when light, all other principles being the same; consequently the midship section is solely the basis for calculations in that form of vessel; that although the midship section, in many of the arguments, has been used dynamically, those midship sections in practice, could be obtained by increased length; and as length is also universally allowed to produce velocity, the principles of strength become of increased importance. I can safely assert, that with the present system in the construction of vessels, we are at its limits. But is this system to continue, with such an example as the Britannia Tubular Bridge? By adopting such a principle, the length of vessels could be safely doubled, and with power corresponding to the extra displacement by such length, the speed of our steamships could be increased 40 per cent. at the same cost per mile.

When it is considered that established facts are all that is required to demonstrate what are the necessary requirements at any velocity, does it not become of the greatest importance to our large steamship companies to supply the necessary data to such a periodical as your own, devoted as it is to Naval Architecture, Marine Steam Machinery, and all matters bearing on the question, to enable you, and those engaged in the advancement of practical Science, to scrutinise, and therefrom deduce practical data available to all engaged and interested in steamship building and in steam navigation? It has been the universal demand for years, and the cost of procuring such data would not be the one-thousandth part of what it has cost owners for repairing the errors of shipbuilders.

I am, Sir, yours respectfully,

September 20th, 1856. R. Armstrong.

ON THE QUANTITY OF HEAT DEVELOPED BY WATER WHEN VIOLENTLY AGITATED.

To the Editor of The Artizan.

Sir,—Being a constant reader and *abonné* to your most valuable Artizan, I take the liberty, by means of your correspondence, to ask George Rennie, Esq., F.R.S., about his experiments—"On the Quantity of Heat developed by Water when violently agitated," occurring in your last Number, September 1, 1856, page 203—whether he really believes the increase of temperature to be produced only by agitating the water? for I am nearly convinced that the increase in question is originated at the wooden spindle-post, *d* (see the vertical section); the friction caused by 270 revolutions per minute must be very great, and so the heat at that place must also be great.

The agitation of the water by means of the twelve vertical agitators but accelerates the communication of heat from the spindle-posts, *d*, to the water contained in the box.

I am, Sir, yours truly,

The Hague, 10*th September*, 1856. A Naval Officer.

BESSEMER'S IMPROVED MANUFACTURE OF IRON.

To the Editor of The Artizan.

Sir,—The process patented by Mr. Bessemer for the improved manufacture of iron is scientifically so beautiful, and promises so great practical results; and besides, the approbation bestowed upon it by the great authority of Mr. Nasmyth is so unreserved—that there may seem something ungracious in even the suggestion that possibly the commercial value of this discovery may not be so great as the sanguine public, judging by reports so favourable, probably anticipate.

We have here a more speedy and a more effective conversion of the crude metal into malleable iron; we get a more pure material at a less expense of labour and fuel. But as far as we yet know, we are no nearer to a strong fibrous quality of bar iron than when, by the process now in use, the puddler has from the same quality of pig completed his work. We have in each case a crystalline metal, to make which, suitable for the purposes of the smith and engineer, we yet have to discover; nor does Mr. Bessemer show us any better means than a succession of passages through the rolls. By this means the fibrous quality is developed, and by each repetition improved. And so we find that with the same mark of bar iron, the larger sizes are never so tough as the small rods: precisely because, although all have been subject to the same processes of faggoting and rolling, yet the metal in its mass has not been so thoroughly worked.

Without, therefore, in the least pretending to depreciate the merits of this invention—which must be of immense social and commercial value, if its only effect were to rid us of the race of puddlers, by substituting a mechanical for a laborious manual process—I wish to explain that commercially its effect cannot be so important as many seem to hope, since this (the puddling) is the only step in the manufacture that is affected. Now, good bar iron is to good pig as 10 to 5 (about) in value. Supposing this proportion altered even to 8, to 5—the extreme reduction to be expected—we have even then no more than frequently occurs as a reduction in the market price, resulting from the constant variations of supply and demand, while the reduction on the finished uses will be but trifling. Apologising for this intrusion,

I remain, yours obediently,

Limehouse, September 18*th*, 1856. C. F. W.

AMPHIBIOUS CARRIAGES.

To the Editor of The Artizan.

Sir,—Amphibious vehicles were invented by Sir Samuel Bentham, in 1781. The first was constructed at Nighue Taghil, a fabric of Prince Demidoff's, and was used by Bentham at the opening of the Government of Perme.

Having the command of two battalions, stationed the one at Kiachta, on the frontiers of China, the other along the banks of the Irtish, above 1,200 miles from each other, he constructed two carriages, of a more simple form than the first, to travel to and fro. In these, while posting, he crossed several rivers without any stoppage at the banks, the horses continuing their course across the river, swimming whenever they got out of their depth. And on his return from Siberia to Prince Potemkin's head quarters, at Jassy, his Highness ordered a corps of Chasseurs to be furnished with these amphibious carriages.

On the General's return to England, in 1794, he constructed a military baggage-waggon for the Duke of York, which his Royal Highness approved of, and exhibited on the Thames.

In 1805 the Emperor of Russia had a baggage-waggon constructed on the same principle at St. Petersburg, a model of which is mentioned in Dr. Granville's work, as deposited at the Admiralty there.

In 1830 Sir Samuel proposed to the Duke of Wellington that all military waggons should be amphibious. In most of these various amphibious vehicles several of his inventions were exhibited, such as the placing the plank diagonally, and forming the hull entirely of metal. Those made for the Duke of York were of tinned copper.*

Mr. Francis has the sole merit of corrugating the iron, and of constructing an efficient apparatus for stamping it. I am, &c.,

M. S. Bentham.

BOILER EXPLOSION AT BURY, August 20.

We condense the most important evidence before the jury at the adjourned inquest, not having space to report it *in extenso*.

The following witnesses were then examined:—

Scholes Bamford, stiffener, said he had worked at Hampson Mill a fortnight at the time of the accident. He arrived at the works on Wednesday morning (the day of the explosion), about twelve minutes after six o'clock, in company with Edward Walker, who has since died. James Barlow, the engineer, was feeding the fire under the boiler that had not burst. He (the witness) called Walker's attention, as they were going in, to the steam that was blowing off from a valve over the boiler which afterwards exploded; the doors of the flues were as wide open as they could be. He had never noticed the steam blowing off before. The explosion took place about three minutes after the steam blew off. He had seen the steam-indicator on the boiler, but had never noticed at what pressure the steam would blow off.—William Barlow was again examined. He said that the valve of the exploded boiler could be seen at the distance of a few yards in front of it. He cleaned out the fires of both boilers about three o'clock on the Wednesday morning.—John Hardman repeated the substance of the evidence he gave on the former occasion, and added that Mr. Warburton, senior, came on the premises on Tuesday evening about eight o'clock, and asked who was in the boiler. He (witness) replied that James Barlow and John Molyneux were there; this was at the time they were repairing it.—George Whewell, Barlow Fold, millwright, said he had worked for six years at Hampson Mills, but left the employ of Messrs. Warburton and Holker about eighteen months ago. He had to do with the boilers, and

* For a printed account of amphibious carriages, see "United Service Journal" for the year 1829, page 579; and in The Artizan, January, 1856, will be found an illustrated description.

with their repair. One of them used to be a little damp on the right hand side, near the brickwork, about 4 ft. from the end; it was not very thick at that place, for the damp had eaten it away. Just before he left the boiler had been "wheezing," and he screwed on a small patch.—Mr. Benjamin Warburton, one of the proprietors of the mill, said he and Mr. Samuel Holker had been partners about eleven years. The boiler, which has burst, was put in about twelve months after they took the mill. Messrs. Newbold and Park were the makers of it; it was intended to work on high pressure, at 40 lbs. per in. It had been in use about five years before it required any repairs: then two new fire boxes were put in by Messrs. Joseph and John Lord, at the firing-up end. About two years since the next repair was made; it was found to leak, and it was "overhauled," and thoroughly repaired by Mr. Pollitt, of Bolton. He took out all the old plates that were bad, and put new ones in; his account came to £11, but he (Mr. Warburton) did not recollect how many plates were put in. Hardman told him there was a hole in the boiler about nine weeks ago, and that he put on a patch; he (the witness) said in that case it must be repaired. He heard of no more repairs until his return from Manchester on Tuesday night week, soon after seven o'clock. He went at once to the works, saw the foremen, and gave his orders to them. James Barlow, who had been engineer about nine years ago, was in the smithy, preparing some bolts with which to repair the boiler. He (Mr. Warburton) asked him if he could make the boiler secure, and he replied he could make it safe for work. He did not say in what part of the boiler the repairs were required, but merely said that it had begun to leak a little; neither did he say how thick the plate was where it must be repaired. He returned to the works after tea, at ten o'clock, and saw James Barlow, who said he had made all fast; the water was running into the boiler at the time. He was accustomed to be on the works every day, except when he went to Manchester, which was generally two days each week, and always noticed the gauge of the two boilers that stood about 18 ft. high outside the boiler-house. He generally also noticed the weights on the outside valve, but not those on the valves upon the boilers. There was only one engineer, Jas. Barlow; the other two men, Wm. Barlow and John Hardman, were fire-beaters. Sometimes in the morning he had found small additional weights, of 2lbs. or 3lbs., on the lever of the outside valve that belonged to both boilers, and he had found fault with the engineer for putting them on, and removed them. That had happened when the water was low. With that exception, he had no complaint to make of James Barlow getting the steam up too high. He was a sober man, and competent to fill his situation; he was a good millwright; his wages were 16s. per week, and his hours from five to five. He had always found Hardman and William Barlow good, safe men; Hardman was the safest man he ever had. Barlow's duties were chiefly those of a watchman. The pressure would seldom be more than 20lbs. during the night. He had never heard of an additional weight being placed on the lever of the valve upon the boiler, nor had any complaints been made to him at any time of too great pressure being on. He was not aware that any one had told him, within the last four years, that if he was not careful there would be an explosion, nor had his engineer ever informed him that he had been told so. He was not a member of the Society for the Prevention of Steam Boiler Explosions, but he had been asked to join it. He had heard that large boilers were unsuitable for high pressure, but he would not have feared to stand before the boiler which has exploded if the pressure had been at 60lb. He believed it was customary to put a patch upon a boiler when there was a small hole in it. Some time after Hardman repaired the boiler, nine weeks ago, he told him (Mr. Warburton) that he thought the thickness of the plate was about a ¼ in. It was intended to continue the use of the boiler that has burst, but as soon as the new one (a third) was in working order he had meant to have it repaired. No one had left the works assigning as a reason his fear respecting the boiler; only one man had left for some time, and his children were still at the works. When he was told about the crack, it was not mentioned to him that it had extended from 2½ in. to 8 in.—Mr. James Park, engineer, Bury, said he had been an engineer thirty years. When he made the boiler that has burst, in 1845, he had two partners, named Newbold. It was properly made as a high-pressure boiler. The thickness of the plates was fully 3-8ths of an in. on the shell, aud on the end either 5-8ths or ⅝ of an in. Since that time he had nothing to do with the boiler, except once or twice in advising about it. It was difficult to say how long a boiler plate would retain its tenacity, as it depended on so many contingencies, such as dampness, shortness of water, and over pressure; but when none of those influences were operating, boiler plates would still lose their tenacity in the course of years. In the absence of a knowledge of the causes existing to deteriorate the boiler, he could not say in what ratio it would deteriorate. He was asked to examine the boiler on the day of the explosion, by Mr. Thomas Grundy (solicitor to the firm), in order to ascertain if possible the cause of the accident. He found that external corrosion had been going on, and had affected about half a dozen plates, more than he could have expected. He never saw anything to the same extent before. The thiekness of the plates varied from 1-8th of an ineh to the ordinary thickness, but he did not gauge it. He eame to the conclusion that the eorrosion of the plates was a sufficient cause of the explosion. The valves were, he considered, in a good working condition. The boiler, when made, was calculated to work at a pressure of 40 lbs. Had he known the state of the plates at the time of the explosion, he should have hesitated to name any pressure as safe. The boiler plates were nearly uniform in size when made, and averaged, if he reeollected aright, 2 ft. 2 in. in width, and 5 ft. 6 in. in length. In putting the plates together, it was the modern practiee to break the joints, the effect of which would be to distribute the stiffness of the boiler better, and enable it, though not to a considerable extent, to bear a greater pressure. This was not the practice when the boiler in question was built. In the absence of the three corroding causes he had named, he should think such a boiler as the one which has exploded would last from 20 to 30 years, merely requiring repairs about the fire-place during that time. He had no doubt the rehad been a pressure of more than 40 lbs. on the boiler shortly before the explosion. Had he known that James Barlow was working for 16s. per week he should have been prejudiced in his opinion of his capabilities; but in the absence of that, he thought his intelligence was above the average. He (Mr. Park) had an engineer in his own employ to whom he paid 15s. per week; the man was very well satisfied with it—(laughter)—but he superintended him. As to the patching of boilers he was sorry to say there was too much of it; it was a practice he would never advise nor recommend. The corrosion was caused by a percolation of water through the wall, and through the brickwork forming the bed of the boiler, which eontinually saturated the boiler; he feared this would not be very apparent to any one. He found no evidence inside the boiler of anything of this kind going on. His theory to account for boiler plates being corroded was, that the moisture absorbed the sulphur from the coal after it had passed through the flues, aud converted it into sulphuric acid, which was very corrosive; he was not sure whether his chemistry was correct, but that was his idea of the matter; he knew nothing that ate away a boiler so soon as this. The explosion in this case would not have occurred had the corrosion only affected one plate, but it had extended to a series of about half a dozen. The boiler was stayed by a longitudinal iron bar about 2 in. or 2¼ in. in diameter, but thicker at one end; diagonal stays were afterwards added.—Thomas Baldwin, civil engineer, Bury, said he went down to the mill on the morning after the accident, by the authority of the superintendent of police, who conveyed to him the instructions of the coroner to that effect. He made a complete examination of the place, as far as possible, and had prepared a report which, after describing minutely the size and position of the boilers and their appendages, and the effects of the explosion in carrying various portions to great distances, proceeded thus:—

I examined the safety valves, and found them in working order, there being no signs of the valves or joints having been fast in any part. The 5-in. safety valve has brass lid and seating, the lengths of lever being to where the weight was suspended 2 ft. 9½ in., distance between fulcrum and valve 3 in., weight and hook 66¼ lbs., weight of lever aud joint 9½ lbs., centre of gravity of lever and joint 14 in. from fulcrum, weight of valve 5 lbs., which gives 40·17 lbs. sq. in. as the pressure in the boiler. The safety valve fixed on the steam pipes is 6⅛ in. diameter, length of lever 4 ft. 2 in., rod and four weights, attached to lever by pin aud joint, 114¾ lbs.; distance from fulcrum to centre of valve, 5 in.; weight of valve, 7¾ lbs.; weight of lever, 21 lbs.; distauce from fulcrum to centre of gravity of lever, 20 in., which gives 42·05 lbs. per sq. in. as the pressure at which the steam would blow off by this valve. I was present when the rod and weights of this valve were removed from under at least a yard in depth of broken bricks. Only fonr weights were attached to the rod, amounting in the aggregate to 114¾ lbs., as stated above. The valve for transmitting the high steam into the low pressure pipes, as before-mentioned, is 8¼ in. in diameter, and works perfectly free; length of lever, 2 ft. 7 in.; distance from fulcrum to centre of valve, 6⅝ in.; weight of spindle and valve, 11½ lbs.; weight of lever, 14½ lbs.; distance of centre of gravity of lever from fulerum, 15½ in. At the end of the last-named lever a rod 23 lbs. in weight is attached, and passes through the floor into the room below, being again attached to another lever at a distanee of 12 in. from the fulcrum; this last lever is 11 ft. 1½ in. in length, and 29½ lbs. in weight, the distance of the centre of gravity of the lever being 4 ft. 8¼ in. from the fulcrum. There are also two weights hung upon this lever, one of 60 lbs., at a distance of 17⅛ in. from the fulcrum, the other being 25 lbs. in weight, and hung at a distance of 3 ft. 5½ in. from the fulcrum. The whole of these elements being taken into calculation, gives us as the force acting against the high-pressure steam, 29·951 lbs. on each sq. in. Before we can arrive at the pressure requisite to lift the last-named valve, the pressure in the low-pressure pipes must be aseertained. On the low-pressure pipes a safety valve of 8⅛ in. in diameter is fixed; length of lever, 36 in.; distance from fulcrum to eentre of valve, 6⅛ in.; weight hung on end, 72 lbs.; weight of valve, 10 lbs.; of lever, 9½ lbs.; distance from fulcrum to centre of gravity of lever, 12 in. These elements give the pressure at which the steam would blow off at 8·71 lbs. per sq. in. Knowing the diameter of the upper side of the 8¼-in. valve, we obtain the area of the upper side, which, divided by the area of the underside, gives 8·79 lbs. as the force per sq. in. acting on the upper side of the 8¼-in. valve. Hence 29·951 + 9·79 = 39·74 lbs., the pressure per sq. in. required to lift the 8¼-in. valve. Taking the mean of the pressure given by these three valves, we have 40·65 lbs., say in round numbers the pressure in the boiler was 40 lbs. to the sq. in.

Having now ascertained that the pressure in the boiler was 40 lbs., and knowing also from observation on the morning of the accident that the valve which coupled the boilers together was wide open, it remains to show what may have been the cause of the accident. I am strongly of opinion, that this melancholy catastrophe was caused by the thin plate before mentioned, not having sufficient tenacity to retain a pressure of 40 lbs. per sq. in. acting upon it; that the thin part of the plate was blown out, and probably the patch along with it. The rents made in the plates by this action would soon spread over the surface of the shell, giving increased destructive force, because gaining increased leverage by the steam acting upon the liberated plates, the continuous line of rivets offering great facility to the active force, by allowing it to act in straight lines through the weakened part of the boiler. The great diameter of the boiler would also facilitate its destruction, for so soon as the longitudinal line of rivets were rent asunder, the force of the steam would act on that part and open out the shell, stretching it out nearly in a straight line at right angles to the longitudinal axis of the boiler. The boiler having been at work about ten years, the iron would have decreased very much in tenacity, for it has been proved experimentally, that iron used as boiler-plates will in a few years lose one-third of its retaining power. As to that part of the flue thrown across the river, I feel certain that 40 lbs. per sq. in. is more than sufficient to account for that phenomenon. The area of the longitudinal section of the tube is 56·65 sq. ft., or 8147·6 sq. in., and its weight about 2,914 lbs., or rather more than $1\frac{1}{2}$ tons; hence by dividing 2,914 by 8147·6, we have 357 lbs. as the weight or force of gravity acting on each sq. in. of the section of the tube. The steam acting on this surface would require a pressure of about 28 lbs. per sq. in. to throw the tube a distance of 180 ft. (the distance to which it was hurled), the angle of elevation being 45°, the remaining 12 lbs. per sq. in. being more than would be necessary for the resistance of the air, which is very little for small velocities. In the present case, the velocity of the tube in its flight would be about 80 ft. per second; that of a locomotive engine when running 1 mile per minute, 88 ft. per second nearly, the resistance of the air being about 3 lbs. per sq. ft. The weight of the boiler and water would be about $56\frac{1}{2}$ tons, or 126,507 lbs.; its longitudinal section about 47,742 sq. in. The former divided by the latter gives 2·65 lbs. per sq. in. of steam merely to lift the boiler. When 14 times this force is applied, having the power of motion within itself of 172 ft. per second, we need not be surprised at the dreadful havoc committed by this powerful agent. With respect to the tearing of the cast-iron plate through the front end of the boiler, this must have been accomplished with a force less than that required to tear asunder the longitudinal stay, the diameter of which is $1\frac{3}{8}$ in. at the smallest part of the screw, requiring a force of 64 tons to tear it asunder; hence I conclude that a force less than 64 tons pulled the cast-iron plate through the boiler end. The force acting against the boiler-end just before the explosion would be about 134 tons.

Boilers larger than about 6 ft. in diameter cannot be too highly censured, when the pressure exceeds 20 lbs. The exploded boiler was not of the best construction, the ends being badly stayed, and the plates rivetted together with the longitudinal joints continuous, thereby losing about one-third of its retaining power. No bricksetter would ever think of building a wall without crossing the vertical joints of the brickwork. It has been stated, since this accident occurred, that since high steam possesses a higher temperature than low steam, the strength of boiler-plates is much decreased by this increase of temperature. This, however, is not correct, since the maximum strength of wrought-iron plates is found to obtain, at a temperature of 570° Fahrenheit, the temperature of the steam in the present case being only 288° Fahrenheit. Hence, the strength of the boiler is increased by the addition of heat, up to its maximum. Taking 25,000 lbs. as the ultimate strength per sq. in. of section, for rivetted plates, where the joints are not crossed, one-fifth of which ought not to be exceeded by boilers in constant use, viz., 5,000 lbs. per sq. in. of section, we find, by multiplying twice the thickness of the plate by 5,000, and then dividing by the diameter in inches, that about 34 lbs. per sq. in. would be about a fair pressure to have worked the exploded boiler, supposing all its plates in good condition, and the boiler judiciously stayed.

Mr. Baldwin added that he never knew a boiler, the pressure of which exceeded 30 lbs., to be patched as this one had been. As to the Smith's Indicator, he had seen hundreds of them, and only knew one or two to be correct; there was one in Bury at present which he had known to indicate 50 lbs. when the pressure in the boiler was 75 lbs. on the sq. in. —John Molyneux was re-called and identified the plate of iron, which was produced, as the patch that he had put upon the boiler.—The jury found as follows:—"We find that the death of John Cumstive has been caused by the explosion of the steam boiler at Hampson Mills, and that the said boiler was very defective, and working at a much higher pressure than it was calculated to bear. We find that the said boiler was corroded by the action of dampness, to about one-third of its original thickness, on that part of the boiler resting upon the brickwork or seating. We are also of opinion that sufficient caution had not been exercised by the owners, they not having had the boiler latterly examined by competent persons, and we recommend that government take measures to have steam boilers regularly inspected."

LIST OF NEW BOOKS OR NEW EDITIONS OF BOOKS.

BREWSTER (D.)—The Stereoscope; its History, Theory, and Construction: with its Application to the Fine and Useful Arts, and to Education. By Sir David Brewster. Post 8vo, pp. 236, cloth, 5s. 6d. (Murray.)

DAVIES (T. S.), RUTHERFORD (W.), and FENWICK (S.)—The Mathematician, edited by Thomas Stephens Davies, William Rutherford, and Stephen Fenwick. 3 vols, 8vo, pp. 1,052, cloth, 21s. (Spon.)

DEMPSEY (G. D.)—Working Drawings of Stations and Engine-Houses, Manufactories, &c. By G. D. Dempsey. Folio, sewed, and letterpress. 4to, sewed, 52s. 6d. (Atchley.)

HARDY (R. W. H.)—Incidental Remarks on some Properties of Light; being Part V. of an Essay on Vision. By Lieut. R. W. H. Hardy. 8vo, pp. 66, cloth, 3s. 6d. (Bell.)

LONG (C. A.)—Practical Photography on Glass and Paper. By C. A. Long. 2nd edit., 12mo, sewed, 1s. (Bland.)

SCHEERER (T.)—An Introduction to the Use of the Mouth-Blowpipe. By Dr. Theodore Scheerer. Together with a description of the Blowpipe Characters of the Important Minerals. The whole translated and compiled by Henry J. Blanford. 12mo, pp. 240, cloth, 3s. 6d. (Williams and N.)

SCHUBARTH'S REPERTORIUM.—Subject Matters. Index to the Published Inventions of All Nations, 1823 to 1853 inclusive. Royal 8vo, cloth, 24s. (Trübner.)

LIGHT; its Nature, Sources, Effects, and Applications. Illustrated by a Photograph. 12mo, pp. 300, cloth, 4s. (Soc. P. C. K.)

GORE (G.)—Theory and Practice of Electro-Deposition; including every known Mode of Depositing Metals, &c. By George Gore. Post 8vo. pp. 104, cloth, 1s. 6d. (Houlston.)

GUMPACH (J. v.)—A Popular Inquiry into the Moon's Rotation on her Axis. By Johannes von Gumpach. 8vo. pp. 188, cloth, 6s. 6d. (Bosworth.)

JOHNSTON (J. F. W.)—Elements of Agricultural Chemistry and Geology. By James F. W. Johnston. 7th edition. 12mo, pp. 420, cloth, 6s. 6d. (Blackwood.)

LARDNER (D.)—Handbook of Natural Philosophy. Vol. IV.—Electricity, Magnetism, and Acoustics. By Dionysius Lardner, LL.D. 12mo, cloth, 5s. (Walton.)

*DAHLGREN (J. A.)—Boat Armament of the U. S. Navy. Designed by, and executed under the direction of, J. A. Dahlgren, Commander U.S.N. 2nd edition, crown 8vo. (Philadelphia), pp. 216, many plates, half-bound, 18s.

*LESLEY (J. P.)—Manual of Coal and its Topography. Illustrated by Original Drawings, chiefly of Facts in the Geology of the Appalachian Region of the United States of North America. By J. P. Lesley. 8vo. (Philadelphia), pp. 224, cloth, London, 6s.

BREEN (H.)—Practical Astronomy; being a Guide to the Scenery of the Heavens, the Planetary Movements, and the Practical Use of Instruments. By Hugh Breen. Post 8vo, pp. 256, cloth, 2s. 6d. (Houlston).

BONNER (E.) and SCOFFERN (J.)—The Chemistry of Food and Diet; with a Chapter on Food Adulterations. By Edward Bonner and John Scoffern. Post 8vo, pp. 122, cloth, 1s. 6d. (Houlston).

BUCHANAN (W.)—A Technological Dictionary, explaining the Terms of the Arts, Sciences, Literature, Professions, and Trades. By W. Buchanan. New edition, 18mo, cloth, 4s. 6d. (Tegg.)

ENCYCLOPÆDIA BRITANNICA; or Dictionary of Arts, Sciences, and General Literature. 8th edition, vol. ii, 4to (Edinburgh), pp. 790, cloth, 24s. (Simpkin).

ENGINEERS AND OFFICIALS; an Historical Sketch of the Progress of "Health of Towns' Works" (between 1838 and 1856) in London and the Provinces. 8vo, pp. 258, cloth, 5s. (Stanford).

FORREST (R.)—Illustrated Handbook of Military Engineering, and of the Implements of War. By R. Forrest. Royal 8vo, cloth, 5s. (Day).

GRIFFITHS (J. W.)—Treatise on Marine and Naval Architecture: or Theory and Practice blended in Shipbuilding. By John W. Griffiths. New edition, 4to, cloth, 31s. 6d. (Philip).

LARDNER (D.)—The Museum of Science and Art. By Dionysius Lardner. Vol. ii, bds. 1s. 6d. (Walton).

MALLET (R.)—On the Physical Conditions involved in the Construction of Artillery; with an Investigation of the Relative and Absolute Values of the Materials principally employed, and of some hitherto unexplained causes of the Destruction of Cannon in Service. By Robert Mallet. 4to, pp. 300, cloth, 30s. (Longman.)

SCOFFERN (J. B.) and LOWE (J. E.)—Practical Meteorology; being a Guide to the Phenomena of the Atmosphere, and the Practical Use of Instruments for Registering and Recording Atmospheric Changes. By J. B. Scoffern, and J. C. Lowe. Post 8vo, cloth, 1s. 6d. (Houlston.)

WEBB (J. E.)—Instructions for the Engineers' and Mechanics' Improved Slide-Rule; with a Description of the several Lines upon it, and plain Directions how to find any Number thereon; together with the application of those Lines to Multiplication, Division, Rule of Three, &c.; the Mensuration of Superfices and Solids is likewise made perfectly easy: it is also particularly useful in weighing all kinds of Metals and other bodies; to which are added a complete Table of Gauge Points for weighing the different articles contained therein; also, a Table for the Weight of Cast-Iron Pipes, &c. Compiled from various Works by E. J. Webb. 2nd edition, corrected and enlarged. Hyde, 6d. (Booth.)

WILLIAMS (C. W.)—Prize Essay on the Prevention of the Smoke Nuisance. By Charles Wye Williams. Imp. 8vo, pp. 52, sewed, 2s. 6d. (Weale.)

BURN (R. S.)—The Illustrated Drawing Book, for the Use of Schools, Students, and Artizans. 3rd edition, 8vo, pp. 146, cloth, 2s. (Ward and Lock.)

HUMBER (W.)—A Practical Treatise on Cast and Wrought Iron Bridges and Girders, as applied to Railway Structures, and to Buildings generally; with numerous Examples drawn to a large scale, selected from the Public Works of the most Eminent Engineers. By W. Humber. Published Monthly. Part I., folio, sewed, 2s. 6d. (Spon.)

BACHE (A. D.)—On the Tides of the Atlantic and Pacific Coasts of the United States; the Gulf-Stream, and the Earthquake Waves of December 1854. By A. D. Bache. (From the "American Journal of Science," Vol. xxi, 1856). 8vo, (New Haven), 7 plates, pp. 44, sewed, London, 2s. 6d.

* All preceded by an Asterisk are new American Works.

NOTES AND NOVELTIES.

The Fleet of the General Screw Steam Shipping Company.—In the "Daily News," of the 19th September, the following paragraph appeared with reference to the sale of the splendid ships belonging to the General Screw Steam Shipping Company:—"We referred yesterday to the sale of four of the smaller vessels of the General Screw Steam Shipping Company. Two of these, viz., the *Propontis* and the *Harlingen*, were purchased, we understand, by a Russian naval officer of rank for account of the Russian government. The sum paid for them is stated to be £23,000, a price which seems to be considered satisfactory to the shareholders. It is also reported that the directors are in treaty for the sale of twelve of the larger vessels."

RECOVERY OF SUBMERGED PROPERTY.—A scheme, said to be based upon scientific principles, is about to be resorted to, with the view of regaining sunken ships, with other extensive property submerged, as along our own coasts. The apparatus is the patented invention of Captain Stephen Randoll Smith, who has entered into an arrangement with the Sunken Vessels Recovery Company, lately formed under the Limited Liability Act, for the carrying out of his plans. The apparatus requires a steam-tug and two large flat-bottomed ships, peculiarly constructed with regard to buoyancy and calibre. They are to contain machinery capable of giving a lifting power of 1,360 tons, of submerged matter.

ATLANTIC SUBMARINE TELEGRAPH.—Another step in the preparations for establishing a submarine telegraph between America and Europe has just been completed. A month back the New York, Newfoundland, and London Telegraph Company, by whom the enterprise is undertaken, succeeded in laying down a cable, manufactured by Kuper and Co., of London, from the northern point of Nova Scotia to Cape Ray, Newfoundland, a distance of 85 miles, and this will be extended across Newfoundland to St. John's Bay, whence the ocean distance to the west coast of Ireland is 1,640 miles. Meanwhile the small steamer *Arctic* was despatched by the United States' Government, under the command of Captain O. H. Berryman, to make soundings between these two points. She is said to have performed satisfactorily the object of her voyage.

PHOTOGRAPHY BY LAMP-LIGHT.—Dr. Lover, the eminent lecturer on natural philosophy, states that the oxydate lamp, invented by Mr. Nibbs, of Bakewell, gives forth such a pure and steady light from a very thin and perfectly white sheet of flame, that it is applicable to the copying of collodion photographs by night, and is also well suited to the microscope.—*Atlas.*

NEW PAPER AND PULP STEAM-MILL, WOOLWICH.—The newly-erected paper and pulp steam-mill in Woolwich Arsenal has commenced operations under the most favourable auspices. The labours for the present are to be confined to the manufacture of cartridge bags only, of which the machinery in its present state (under the personal superintendence of Mr. Macintosh, the patentee) turns out a sufficiency, under ordinary circumstances, for the supply of the whole British army and navy. Its capabilities average about 20,000 bags per hour, ready for being filled. The principal portion of the machinery, which is on a new and perfectly unique principle, was supplied by Messrs. B. Hick and Son, of Bolton, and consists of driving engines and boilers, pumps, pulp reservoirs, paper-cutting machines, various dry apparatus, &c., as well as the factory engine of 40 H.P., the steam piping, iron pillars, roofing, and numerous fittings. The knitting machine is from the firm of Messrs. Perry and Son, of Aberdeen; and the cisterns by Messrs. Blakie, of Aberdeen. Other machinery will eventually be added to the establishment for the manufacture of every kind of paper required in the various departments of Her Majesty's service. This will effect a considerable saving, as the cost of the materials employed in the manufacture of the articles will be comparatively nothing; an immense part of them, such as linen and other rags, being supplied from the barracks and other Government institutions.

RAILWAY BRAKE.—The *Memorial Bordelais* of the 11th ult., publishes an account of some experiments made recently at Bordeaux, to test the invention of M. Pelissier for stopping railway trains at full speed. Five trials of the new invention were made, and all are reported to have been successful. The first trial was at the speed of 39 kilometres the hour, and the train was brought to a standstill at 27 metres. The second trial was at a speed of 46 kilometres, with the stoppage at 42 metres; the third at a speed of 50 kilometres, stoppage at 50 metres; the fourth at a speed of 48 kilometres, stoppage at 49 metres; the fifth at a speed of 49 kilometres, stoppage at 41 metres. Considering that, with the existing system of brakage, stoppage of a train is not effected without reversing the engine and slackening speed for a distance of from 300 to 400 metres, this result was hailed with satisfaction by the spectators. The stoppage, moreover, took place without the slightest shock or oscillation. M. Pelissier's plan consists not in putting a brake upon the wheels, but in stopping the motion itself of the wheels, which is not the same thing. This he effects by a very simple and ingenious piece of mechanism. The rotary motion of the wheels is immediately stopped, and the train, after gliding along the rails for a short distance, stops from its own dead weight. Further experiments are to take place shortly.

NEW REPEATING PISTOL.—By C. S. Pettengill, of New Haven, Conn.—This invention relates to that description of repeating fire-arms, in which a chambered cylinder is arranged to rotate on an axis parallel with the barrel. The main object of the invention is to allow the operations of rotating the breech and firing to be performed easily with a simple arrangement of mechanism operated by a single pull on one trigger. The invention consists in certain arrangements and combinations of the parts of the lock, by which the hammer is made self-cocking after every fire, and the main spring is relieved from all strain while the hammer remains cocked. Other features of the invention consist in certain novel arrangements and combination of mechanical devices, by which the rotating of the cylinder, the locking of the same at the time of firing, and the letting off of the hammer are effected. This pistol is one of the most practical and ingenious improvements of its class that we have seen.

PAPER FROM SUNFLOWERS.—Near Erith a crop is about to be gathered of about four acres of sunflower. The seeds will be used for oil, and to feed cattle and poultry, as in the south of France; but the chief object is to obtain the fibre of the stalks for paper-making. If the cultivation succeeds, it is expected to supply abundant materials for fine writing and printing papers, as well as fine and coarse for paper-hanging.

GAS IN OMNIBUSES AND STEAMBOATS.—Gas has been introduced into the omnibuses and diligences in the neighbourhood of Lyons. It is carried in a cylinder under the feet of the coachman, and communicates, by means of a pipe, with the inside. Gas is being also introduced into the American steamboats.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 3rd May, 1856.

1052. E. Thomas, Holywell-st., Millbank—Counting apparatus for ascertaining and indicating the number of rotations made by shafts.

Dated 5th June, 1856.

1344. D. C. Dallas, Islington—Photographic and photogalvanographic processes.

Dated 9th June, 1856.

1371. W. Smith, Hastings—Material for the destruction of flies, gnats, and other insects.

Dated 16th July, 1856.

1675. D. Bowlas, Reddish, Lancashire—"Throstles," and doubling frames for spinning and doubling cotton.

Dated 23rd July, 1856.

1748. H. Doubleday, Coggeshall, Essex—Manufacture of starch.

Dated 25th July, 1856.

1765. G. Spencer, 6, Cannon-st.-west—Couplings of feed-pipes of locomotive steam-engines and tenders.

Dated 30th July, 1856.

1802. R. A. Brooman, 166, Fleet-st.—Ladies' skirts and dress-improvers.

Dated 1st August, 1856.

1817. W. Paton, Springvale, Glasgow—Railway wheels.
1818. A. Tolhausen, 7 Duke-st., Adelphi—Flexible pocket-umbrella.
1819. J. W. Brett, Hanover-sq.—Letter and numeral printing electric telegraphs.
1820. W. Wood, Monkhill, near Pontefract, and M. Smith, Heywood, Lancaster—Looms for weaving terry and cut pile fabrics.
1821. W. Wood, Monkhill, near Pontefract, and M. Smith, Heywood, Lancaster—Cutting the wires out of terry fabrics.
1823. E. P. Chevalier, Brussels—Cigars.
1824. R. A. Tilghman, Philadelphia, U.S. — Hydro-extractors or centrifugal machines.
1825. R. Reeves, Bratton, Westbury, Wilts—Machinery for sowing or depositing seeds and manure.

Dated 2nd August, 1856.

1827. O. Long, Cornhill—Knife-cleaners.
1828. R. A. Brooman, 166, Fleet-st.—Artificial fuel.
1829. T. Donkin, Bermondsey—The glazing of paper.
1830. J. Rhodes, Holborn Brass Foundry, Nottingham—Machinery for reducing turnips and other vegetable substances to a pulpous state.
1831. T. Green, Leeds—Mowing machinery.

Dated 4th August, 1856.

1832. J. Harris, Dolgelly, Merioneth, N.W.—Collecting and condensing smoke and gases generated in furnaces.
1833. C. G. Gottgetreu, 41, Charterhouse-sq.—Lithographic printing in oil and varnish colours and metal.
1834. N. Cadiat, 12, Rue de l'Odèon, Paris—Centrifugal force for purifying liquids.
1835. C. T. Launay and J. Chopin, Paris—Increasing the illuminating power of gas.
1836. G. Walker and J. Scrimgeour, Belfast—Spinning frames.
1837. T. B. Daft, Dublin—Manufacture of cast-iron pipes.
1838. A. Wright, Milbank-st., Westminster—Lighting mines and subterranean places with gas.
1839. J. Firth, Heckmondwike, Yorkshire, and J. Crabtree, Mill-bridge, near Heckmondwike—Weaving Scotch, Kidderminster, and Dutch carpets by means of a power-loom.

Dated 5th August, 1856.

1840. H. W. Wood, Briton Ferry, Glamorganshire—Manufacture of fuel, and for a new mode of preserving coal and coke and other fuel.
1841. J. B. Bowen, Chipping Norton—Manufacture of gloves.
1842. C. F. Vasserot, 45, Essex-st., Strand—Cutting nuts, screws, and pieces of polygonal shape.
1843. T. Maples, Derby—Corn-mills.
1844. A. D. Sisco, Paris—Railway brakes.
1845. A. Smith and W. Smith, Mauchline, Ayr, N.B.—Ruling or delineating ornamental figures.
1846. J. J. Danduran, 13, Charlotte-st., Fitzroy-sq.—An apparatus called the self-swimmer.
1847. E. Blomeley, Fernhill-mill, Bury—Manufacture of fabrics.
1848. J. Keith, Eltham, Kent—Machinery for making envelopes.
1849. A. V. Newton, 66, Chancery-la.—Primers for fire-arm cartridges.
1850. A. Pfaltz, Massachusetts—Making soap from rosin.
1851. J. A. Monnier, Marseilles—Motive-power.

Dated 6th August, 1856.

1852. A. Mitchell, Liverpool—Exhibiting and distributing advertisements.
1853. G. H. Palmer, Adelaide-rd., Haverstock-hill—Furnaces for generating heat.
1855. W. Watt, Belfast—Preparing Indian corn and other grain for fermentation and distillation.
1856. T. Evans, jun., Belmont-ter., Lewisham-rd.—Improvements in harness.
1857. W. Hall, E. Wylde, and W. Waite, Birmingham—Steam-engines.
1859. J. Farrar, Bury, and H. Spencer, Rochdale—Apparatus for regulating the pressure and flow of gaseous liquids.
1860. L. Weber, Bruxelles, Belgium — Keys of door-locks to prevent their being opened by pliers from the outside.
1862. W. Green, York-st., City-rd.—Production of fabrics and surfaces, leather for bookbinding and other uses, and in machinery for effecting the same.
1864. C. Defries, Houndsditch—Roof lamps of railway carriages.

Dated 7th August, 1856.

1861. A. T. N. Goll, 57, Rue de Brètagne, Paris — An improved button.
1863. S. King, Brighton—Spirit lamps.
1865. C. Wright, 20 and 21, Green-st., Southwark—Preparation of lubricating materials.

Dated 8th August, 1856.

1866. R. Davenport, 12, Jonathan-st., Vauxhall—Kilns, to enable them to consume their own smoke.

1867. J. Leese, jun., Manchester—Machinery for printing calico and other fabrics.
1869. T. Austen, Waltham Abbey, Essex—Propelling force of gunpowder.
1870 W. Gorse, Birmingham—Improved door fastener.
1871. W. E. Newton, 66, Chancery-lane—Composing and distributing types.
1872. J. Stephens, Suffolk-pl., Westminster — Pipes for smoking.
1873. D. Fehrman, Liverpool—Lamps adapted for burning resin oil.

Dated 9th August, 1856.

1875. W. Webster, 22, Bunhill-row—Valve-cock.
1876. T. Whittaker, Accrington — Washing or cleansing woven fabrics.
1877. E. Kopp, Paris—Gas.
1878. J. Darlington, 86, Cannon-st.—Super-heating steam.
1879. E. E. Amyot, Paris—Pulp for paper and pasteboard.
1880. C. March, Alwalton Mills, Huntingdonshire—Propelling and working ships and vessels.
1881. A. L. Reid, Glasgow—Ornamental figures or devices on textile fabrics.
1882. E. Owen, Aberdeen-ter., Blackheath—Manufacture of gas.
1883. G. Anderson, 22, Queen's-rd., Dalston—Taps or valves for regulating the passage of gas.

Dated 11th August, 1856.

1884. P. Armand le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Electro-motive engine.
1885. J. Cartland, Birmingham—Door-spring.
1886. A. Symons, George-st., Mansion-ho., and E. Burgess, Clerkenwell-gr.—Tell-tales, and in the application of electricity to such apparatus.
1887. R. A. Brooman, 166, Fleet-st.—Fermenting agent.

Dated 12th August, 1856.

1888. N. D. Maillard, Dublin—Mechanical and magnetic compass.
1889. A. R. Janet, Perigueux, France—For taking measure of coats.
1890. E. Firth, Flush Mills, Hickmondwike, near Leeds—Finishing mohair cloth.
1891. J. W. Downing, Birmingham—Metallic and other wheels and pullies.
1892. W. H. Brown, Albion Iron and Steel Works, Sheffield—Steam-hammers.
1893. J. Hardaker, Leeds—For stopping railway trains; alarm signals.

Dated 13th August, 1856.

1894. D. Lesser, Manchester — Apparatus for making "lozenges."
1895. R. D. Kay, Accrington, Lancaster—Washing, scouring, cleaning, preparing, and dyeing.
1896. W. Church and H. W. Hamlyn, Birmingham—Methods of constructing hay and other ricks.
1897. J. B. Clara, 39, Rue de l'Echiquier, Paris—Steam and the gaseous products of combustion for obtaining motive-power.

Dated 14th August, 1856.

1898. R. A. Brooman, 166, Fleet-st.—Manufacture of artificial stone and building and paving materials.
1899. E. Hallen, Cornwall-rd., Lambeth, and W. H. Kingston, Bandon, Ireland—Signals on railways.
1900. A. Priest and W. Woolnough, Kingston-on-Thames—Horse-hoes.
1901. J. Knowles, Holcombe Brook, Lancashire, and W. Clarke, Manchester—Looms for weaving.
1902. T. Bilbe, Nelson-dock, Rotherhithe—Construction of ships and other vessels.
1903. W. Morgan, 48, Gloucester-ter., Hyde-pk.—Guns and mortars.
1904. J. Bannehr, 11, Bedford-circus, Exeter—Manufacture of name and sign plates.
1905. P. A. Godefroy, 3, King's Mead-cots., New North-rd., Islington—Treatment of rock quartz for the extraction of auriferous, argentiferous, and other metals, &c.
1906. J. Goddard, 29, Moss-row, Bagslate, near Rochdale, and G. Hulme, 4, George-st., Rochdale—Carding engines.

Dated 15th August, 1856.

1907. J. B. Smith, Manchester—Machinery for preparing, spinning, and twisting cotton.
1908. H. C. Hurry, Wolverhampton—Railway crossings.
1909. H. A. Jowett, Sawley, Derbyshire—Rails and railway chairs, and construction of railways.
1910. Col. S. Szabo de Kis-Geresd, Widnes, Lancashire—Motive-power.
1911. C. R. Skinner, St. John's, Worcester—Tanning and finishing off leather.
1912. H. Dubs, Vulcan Foundry, Warrington, and J. Evans, Haydock—Consumption of smoke.

Dated 16th August, 1856.

1913. W. Tranter, Birmingham—Fire-arms.
1914. W. Hargreaves, Bradford—Colliers' combing machine.
1915. G. Slater, J. Williams, and S. Whitaker, Burnley, Lancashire—Power-looms.
1916. D. Chalmers, Manchester—Looms for weaving.
1917. J. W. D. Brown, Burrel's Hotel, London-bridge, and G. G. Brown, Deptford-dockyard—Signal lanterns.
1918. A. Hodgkinson, Springfield Bleach Works, Belfast—Bleaching, scouring, and cleansing plain and embroidered fabrics.
1919. S. Lilley, Birmingham—Manufacture of ships' iron-work.
1920. P. P. Hoffman, Strasbourg—Compound to be used for waterproofing fabrics, paper, leather, or other materials.
1921. L. A. Joyeux, Marseilles—Motive-power.

Dated 18th August, 1856.

1922. T. C. Richardson, 101, Drury-la.—Manufacturing the sulpho-saccharate of sima-rubine.
1923. T. Scott, Barnhill Workhouse, Glasgow—Cooking.
1924. W. Tytherleigh, Birmingham—Rollers or cylinders for printing fabrics.
1925. W. E. Newton, 66, Chancery-la. — Machinery for cutting and finishing metal screws.
1926. W. C. Cambridge, Bristol—Construction of portable railways.
1927. W. E. Newton, 66, Chancery-la. — Machinery for working iron.
1928. J. Stopperton, Isle of Man—Propelling vessels.
1929. R. A. Brooman, 166, Fleet-st.—Stopping railway carriages and trains, and in preventing carriages running off the rails.
1930. A. P. How, Mark-lane—Pumps.
1931. C. M. Chouillon, Paris—Shaving tawed, tanned, or dressed skins.

Dated 19th August, 1856.

1932. J. Leach, W. Turner, and J. Tempest, Rochdale—Rollers for carding wool, cotton, and other fibrous materials.
1933. H. F. Osman, 33, Essex-st., Strand—Electric clock.
1934. P. Noyer, 38, Gerrard-st., Soho—Watches and pocket chronometers.
1935. E. Sutton, 204, Regent-st.—Construction of stereoscope.
1936. H. Burden, Troy, New York, U.S.—Shoes for horses and mules.
1937. R. Jobson, Wordsley—Apparatus for pouring iron or other metal into moulds.
1938. H. Bessemer, Queen-st.-pl., New Cannon-st.—Iron and steel.
1939. J. Brouard and J. Hubert, 39, Rue de l'Echiquier, Paris—Reefing the sails of ships.
1940. J. Apperly, Dudbridge, Gloucestershire—Carding wool or other similar fibrous substances.
1941. W. E. Newton, 66, Chancery-la.—Valves for steam-engines.
1942. A. C. Vetter de Doggenfeld, Trinity-sq., Brixton—Glass ornaments.

Dated 20th August, 1856.

1943. J. H. Johnson, 47, Lincoln's-inn-fields — Steam-engines.
1945. T. Sagar and C. Turner, Burnley, Lancashire—Power-looms.
1947. W. Gossage, Widnes, Lancashire—Obtaining sulphur and metals from certain ores.
1949. W. Stones, Greenhithe, Kent—Machinery for damping sheets of paper intended to be printed upon.

Dated 21st August, 1856.

1951. J. Hacking and W. Wheeler, Clitheroe, Lancashire—Method of winding, warping, sizing, and beaming cotton, woollen, and linen, and in the machinery employed therein.
1952. J. Crossley and J. Bolton, Halifax—Apparatus in the printing of yarns for carpets, &c.
1953. W. Akroyd and J. Thompson, Halifax—Manufacture of carpets.
1955. T. York, Wolverhampton—Improved safety valve and low-water indicator for steam-boilers.
1956. R. Kenton, Birmingham — Manufacture of fishing reels.
1957. W. E. Newton, 66, Chancery-la.—Pumps for raising water.
1958. G. J. Farmer, Birmingham—Machinery to be used in the manufacture of chain links, buckles, &c.

Dated 22nd August, 1856.

1959. T. J. Chipp and R. Bitmead, Soho—Apparatus for drilling and boring.
1960. W. Patten, 22, Old Fish-st., Doctors'-commons—Apparatus for supplying water to the basins of water-closets.
1962. W. E. Newton, 66, Chancery-la.—Machinery for cutting chenille.
1962. C. D. Gardissal, 10, Bedford-st., Strand—Rotary engine.
1963. S. Jay and G. Smith, 246, Regent-st.—Trimming articles of outer attire.

Dated 23rd August, 1856.

1964. F. A. Gatty, Accrington, Lancashire—Dyeing.
1965. P. Benoist, 7, Rue de Lancry, Paris—Construction of stereoscopes.
1966. E. Hallen, Cornwall-rd., Lambeth—Means for washing wool.
1967. J. H. Johnson, 47, Lincoln's-inn-fields — Stocking looms.
1968. J. H. Johnson, 47, Lincoln's-inn-fields—Casting metals.
1969. W. Raester, 28, Francis-st., Woolwich—Apparatus for regulating the supply of gas.
1970. E. Sterlingue, Paris—Preparing for tanning, and in tanning hides and skins.
1971. A. Moses, Cannon-st.-rd. east—Machinery for propelling vessels on water.
1972. G. J. Farmer, Birmingham—Hardening iron and steel.
1973. J. Wadsworth, Hazelgrove, near Stockport—Ventilation of mines, and in removing noxious gases, and in machinery applicable to and to be used for such purposes.
1974. S. Stocks, Collins-gr., near Warrington — Reaping machines.

Dated 25th August, 1856.

1944. J. H. Johnson, 47, Lincoln's-inn-fields—Roller fulling mills.
1946. C. Clark, Somerset-ter., Albion-rd., Stoke Newington—Combining and arranging looking-glasses.
1948. J. Laleman, Lille, France—Machinery for combing flax and other fibrous materials.
1950. J. Maudslay, Lambeth—Steam-engines.
1975. H. Dickie, Girvan, Ayr, N.B.—Machinery for cutting or shaping wood, &c.
1976. M. A. F. Mennons, 21, Rue Napoléon Montmartre—Composition applicable to the coating of metallic and non-metallic surfaces.
1977. W. Webb, Wilson-st.—Reclining chairs.
1978. P. P. C. Barrat and J. B. Barrat, Paris—Steam-digging apparatus.
1979. T. Marples, Derby—Corn mills.
1980. W. F. Plummer, St. Mary's Overy Wharf, Southwark—Apparatus applicable to the grinding of grain.
1981. H. Bessemer, Queen-st.-pl., New Cannon-st.—Manufacture of iron and steel.

Dated 26th August, 1856.

1983. J. Perry, 14, Gt Portland-st.—Photography.
1984. W. H. Perkin, King David Fort, Middlesex—Colouring matter for dyeing with a lilac or purple colour, stuffs of silk, cotton, wool, &c.
1985. W. F. Bush and W. Hewitt, Bristol—Machinery for grinding grain.
1986. J. and T. Horton, Birmingham—Manufacture of paper, pasteboard, and pulp.
1987. C. Carey, the Parade, Harleyford-rd., Vauxhall—Shower baths.
1988. E. A. Cowper, Gt. George-st., Westminster—Manufacture of candles.
1989. James, Earl of Caithness, Barrogill Castle, Caithness, N.B.—Cutting or shaping stone, &c.
1990. E. Simpson, Preston, Lancashire—Cage for mines and pits.
1991. R. W. Vivian, Camborne, Cornwall—Economising the consumption of fuel.

Dated 27th August, 1856.

1994. L. Horrie, Keighley, Yorkshire, and J. Schofield, Rochdale, Lancashire—Method of extracting oil and grease separately from suds used in washing flannel and other woollen goods.
1996. J. and W. Moore, Aston, near Birmingham—Tap or stop-cock.
1997. T. Lees, Stockport—Lubricating parts of steam-engines, and in machinery to be applied for that purpose.
1998. S. Roberts, Hull—Regulating the supply of steam to engines working screw or submerged propellers.
1999. A. V. Newton, 66, Chancery-la. — Projectiles for cannon.
2000. A. V. Newton, 66, Chancery-la. — Machinery for combing fibrous substances.
2001. I. Colbeck, Batley, Yorkshire—Machinery for tearing rags.
2002. W. Green, G. Holloway, and T. Grubb, Kidderminster—Manufacture of rugs.

Dated 28th August, 1856.

2004. C. D. Gardissal, 10, Bedford-st., Strand—Manufacture of artificial fuel.
2006. B. A. Grautoff and C. H. W. Albrecht, Lime-st.-sq.—Construction of pressure and vacuum gauges.
2008. C. Heilmann, 22½, Milk-st., Cheapside—Furnaces of steam-boilers.

Dated 29th August, 1856.

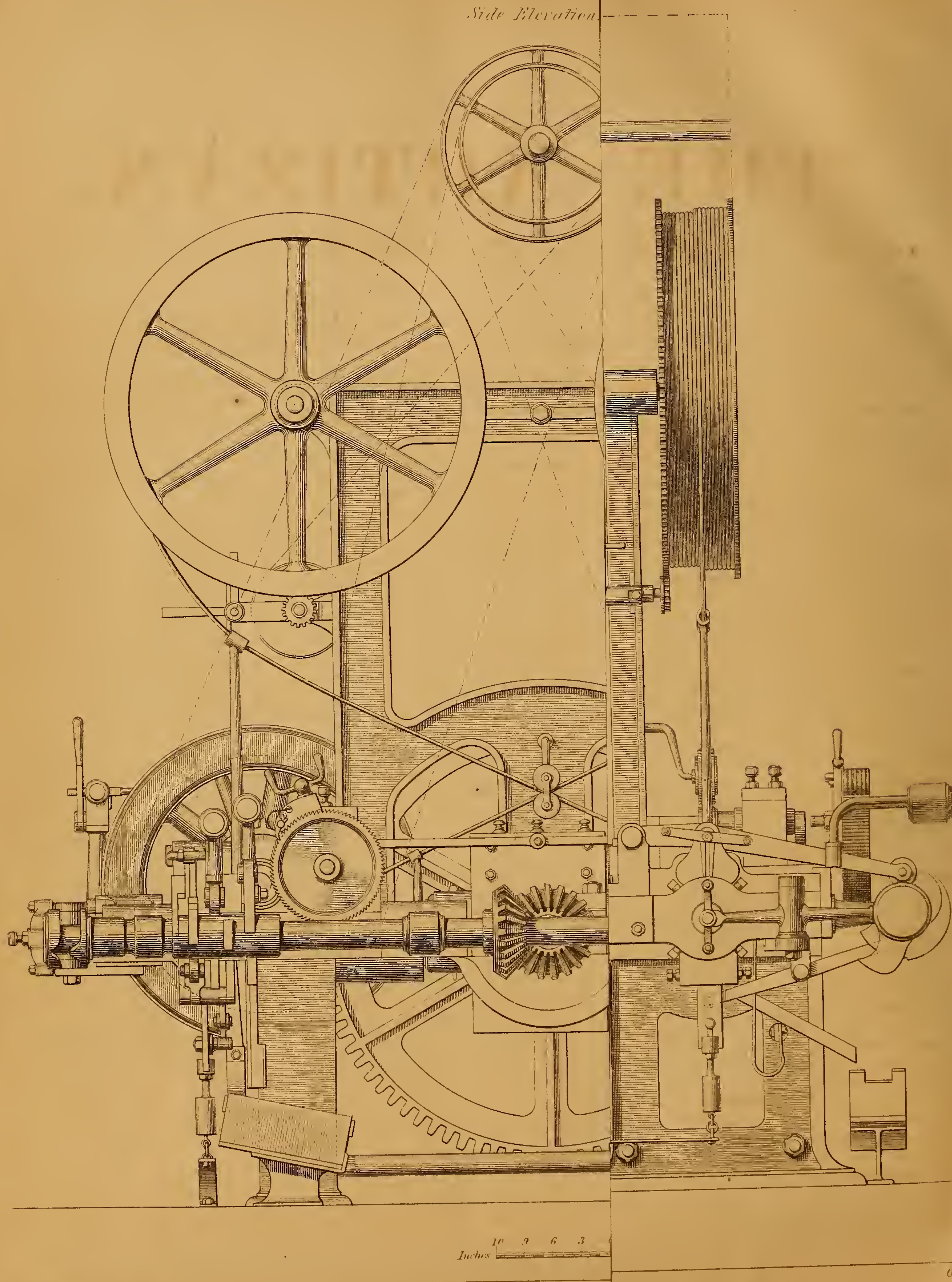
2010. J. Avery, 32, Essex-st., Strand—Bellows.
2012. J. R. Sees, New York, U.S.—Apparatus for heating the feed water of steam-boilers.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

2011. E. Poitiers, 12, Malden-ter., Haverstock-hill—The application of a new material or materials for the manufacture of brooms and brushes in general and for other purposes, and for improvements in the manufacture of street scavengers' and other brooms and brushes.—29th August, 1856.
2033. L. S. Magnus, 3, Adelaide-chambers—Manufacture of coke.—1st September, 1856.
2103. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Flying or roving frames.—9th September, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.
Aug. 19, 3868. W. Thistlewood, Birmingham, "Button, and fastening for the same."
„ 25, 3869. J. and D. Holloway, Birmingham, "Buckle."
„ 27, 3870. Price's Patent Candle Company (Limited), Belmont, Vauxhall, "Candle Lamp."
Sept. 1, 3871. John Broad, Wolverhampton, "Nail and Corn Trimmer."



W. Smith, C.E. direxit

G.B. Smith

THE ARTIZAN.

No. CLXVI.—Vol. XIV.—NOVEMBER 1st, 1856.

THE MACHINERY OF THE WAR DEPARTMENT.

THE CONICAL BULLET-MAKING MACHINERY.

Designed by John Anderson, Esq., Inspector of Machinery to the War Department. (Illustrated by Plate lxxxix.)

Now that the War is over, and the blessings of Peace are again enjoyed by us, we have time to look around and see the changes and improvements which the exigences of the war produced in our arsenals, and we have been much pleased to find that Woolwich Arsenal has, under the able direction of a civilian, so improved in its mechanical means of production, and in the arrangement of such means and appliauces, that we have felt it to be our duty to lay some exceedingly interesting details thereof before our readers.

With this view, we have commenced a series of illustrations of the most ingenious of the mechanical contrivances and labour-saving machines lately introduced into Woolwich Arsenal, and with the present Number give the first of the series, being a double Plate, No. lxxxix., exhibiting two views of Mr. Anderson's conical bullet-making machine.

We shall in our next give some iuteresting general details of the new machinery, tools, &c., erected at Woolwich, and a history of the progress of the improvements effected in connexion with the War Department. In the meantime we confine ourselves to deseribing Mr. Anderson's bullet machinery.

When the Minie rifle was introduced in 1852, the hollow elongated bullet was cast in a metal mould in the usual manner; but from the fact of great accuracy being required, both in the density and dimensions of such projectiles, in order to seeure the full advantages of this admirable weapon, it soon became appareut that a more refined mode of making these bullets was essentially requisite, at the same time it must be such a mode as would secure the necessary softness in the metal, so as to enable it to expand within the rifle, the whole success of the arm being dependent on that condition.

In the earlier attempts in this direction, the bullets were first cast iu a mould, and then stamped accurately with dies in an ordinary fly press: this method is still resorted to by those who have not better machinery.

An attempt was made by the late Mr. Lovel to cast lead into rods of the required diameter, then by means of hand shears to cut these rods into pellets of the required weight, and, with the aid of a fly press and pair of dies, to convert these pellets iuto bullets; but here two difficulties presented themselves.

First. The weight of the bullet depended on the quantity of lead cut off the rod into the pellet; therefore perfect aceuracy in that particular could not be secured.

Seeond. As the whole of the lead cut off to form the pellet had to go towards the eonstruction of the bullet.

The dies had to be made so as to form the required bullet between them, with a certain fixed quantity of lead, any excess being spread over between the dies, and which would have to be pared off by hand; while, on the other hand, any defieieney would allow the dies to come into hard eontact, thus destroying their fine edges, and rendering them useless.

In this condition, and with these objeetions, the shears and fly press were put into the hands of Mr. Anderson, in order to have these difficulties overcome, and the result of his perseverance is in the machine before us.

Plate lxxxix. contains a side elevation and an end view of the machine; while Plate xc. contains two sections and some of the details. (The latter Plate will be given in our next.)

In order to enable the machine to be made self-acting, the lead is squirted into a long rod of about 5 cwt., by means of hydraulic pressure, and whieh is then wound upon a reel placed above the machine, and from which it unwinds as the manufacture proeeeds.

On looking at the plan, it will be seen that there are four separate sets of dies, each of which are complete with lead-reel, cutting-off shears, die apparatus; and otherwise are exactly alike. It will also be seen that the machine is so constructed that one set of driving apparatus, eccentric motion, and cam shaft, are made to serve for two sets of dies, a bullet being formed at each movement.

The process cousists of three operations:—First, eutting off the lead from the rod and delivering it to the dies; second, the forming of the bullet; and third, the mode of stripping off the ring of superfluous lead from the bullet, as it is ejected from the die.

First, the lead rod is unwound from the reel by means of a pair of rollers, which are worked by a ratchet wheel from the reciprocating motion of the maehine. These rollers, after a little working, become so loaded on their exterior surface as to prevent any slip, the amount of motion given to the rollers being dependent on the adjustment of the pall stud in the rocking lever.

The end of the lead rod is pushed through a hole in the lever, this hole being bushed with steel, so as to act as a shear; when the proper quantity is pushed through the hole, the extremity is seized by the pair of nippers, and immediately the end of the lever is raised by a cam, thus separating the piece in the nippers from the rod. So soou as the nippers have the pellet of lead in its own iron fingers, it opens just sufficient to allow it to drop, the lower end of the nippers being so constructed as to hold the lead when it is exactly in front of the dies; at that instant the punch, or moveable die, comes towards the fixed die, and pushes it in a very minute distance sufficient to prevent it from falling; then the nippers open at the bottom and close at the top for the next bullet; the several motions of the cutting lever and nippers being worked by cams of the required shape on the horizontal shaft.

To prevent any irregularity iu the length of lead pushed through the nippers, a crossbar, or stop, is placed behind them, the rollers are set to give rather more than the required quantity, thus butting hard each time; the metal being soft yields, and thus prevents accident to the apparatus.

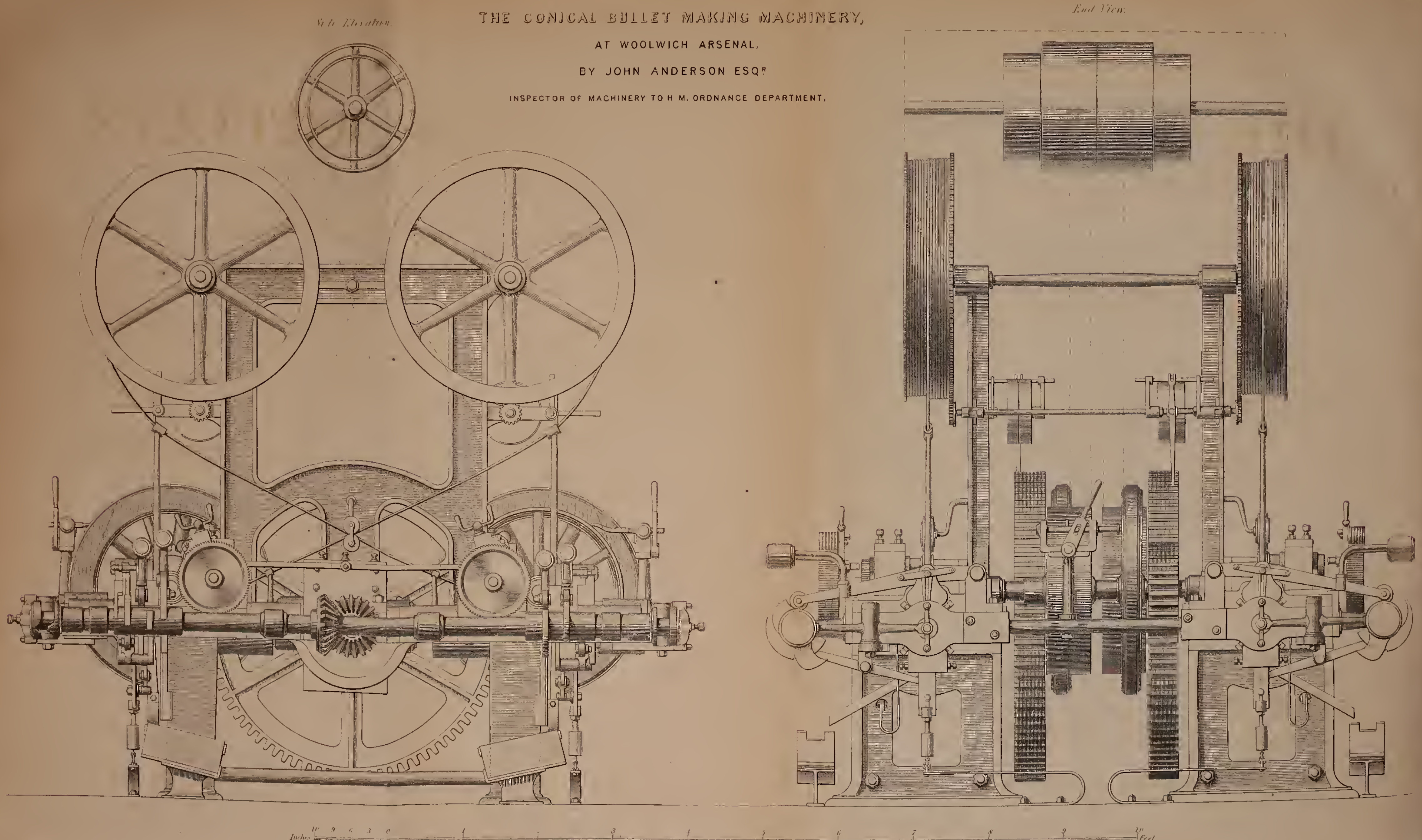
2nd. The dies are by far the most important part, and require to be made with extreme aeeuracy.

THE CONICAL BULLET MAKING MACHINERY,

AT WOOLWICH ARSENAL,

BY JOHN ANDERSON ESQ.R

INSPECTOR OF MACHINERY TO H. M. ORDNANCE DEPARTMENT.



W. Smith C.E. del.

The fixed die is made the shape and size of the bullet, but having a moveable bottom, by means of which the bullet is ejected. The die holder is made adjustable with set screws.

The punch, or moveable die, is fixed in the end of the reciprocating spindle; this forms the hollow interior and rear end of the bullet; the two dies, if brought into contact, thus forming a complete bullet.

In order to allow the lead to fill up into the extremities of the bullet, it is necessary to have not only the fixed die ventilated, but also the punch. The former has a hole through the ejecting spindle about the size of a hair; this allows the air to pass out, but intercepts the lead.

If the two dies that form the bullet were allowed to meet, in order to complete the operation, there would be the constant liability of their coming together without the pressure of lead, which would cause them to destroy each other; for, however rigid the machine might be made, there would be a certain amount of elasticity, which would insure fracture of the dies, to prevent which is the third part of the apparatus.

The two dies are not allowed to meet by about the $\frac{1}{30}$ of an inch, the superfluous lead being formed into a ring or frill around the bullets at the point of junction. When the moveable die or punch has performed its part of the operation it retires, and immediately a third die, in the form of a plate of steel, with a hole in it the exact size of the bullet, rises up in front of the fixed die, and through this hole the bullet is ejected, but the ring or frill is stripped off over the bullet towards the point, thus delivering it complete and ready for the cartridge; and by taking care this hole is of the proper size, it forms a gauge to rectify any wear which may take place in the fixed die.

The motions for ejecting the bullet and for working the steel plate are obtained from cams on the cam shaft, as shown.

Each set of dies can turn out about 32 bullets per minute; the produce of a machine being about 74,000 per day. There are four of these machines at work in the Royal Arsenal, yielding, when in full operation, about a quarter of a million daily; or, if working night as well as day, as was the case during the war, then the double of that quantity.

To have made this latter quantity by the former system, would have cost, in wages alone, the sum of £62 10s.; but, by the introduction of this machine, it is less than the fiftieth part of that amount; while, as regards accuracy, there can be no comparison.

THE GREAT EASTERN STEAM-SHIP.

We presented to our subscribers, with the October number of The Artizan, a large plate, exhibiting three views of the Great Ship; and in our number for December, we shall be enabled to publish a large plate with the lines of the ship accurately laid down to rule.

Since our last notice of the progress of the construction of the ship and the machinery, advances towards completion have been made in every department; and the following is a brief summary thereof, and exhibits the state of the works on the 25th of October.

The bow of the ship is rapidly advancing, and in the course of a few weeks the whole of the fore part of the ship will be complete.

Two large hawse pipes, 16 in. diameter, have been forged, and they will be welded to the stem, the one above the other, so that the large cable will come out exactly in the centre of the stem of the ship.

There only remains a length of 40 ft. to be added to the stern, and some of the plates are already well advanced for this part; so that in the course of a few weeks there will be 640 ft. completed out of the total length of 680 ft.

The boilers for the paddle-engine are now being put into the ship (two of the four sets are already in place), and the parts of the paddle-engine will be hoisted into their places in the ship in a short time.

The paddle-wheels are being constructed, and one is nearly completed, and the boss of the other is cast and partly fitted.

The screw-engines and their boilers, which are being constructed near Birmingham, are expected to be on the works within a month, and they will be, as soon as possible thereafter, placed in their respective positions in the ship.

There are about 1,500 men employed on the ship and engines at the works at Millwall.

About 5-6ths of the total of iron in the hull is now in place and completed.

All the main portions of the machinery for the paddle-engines have been already fitted together in the erecting shop, and excellent specimens of marine engineering they are—highly creditable to the constructors.

The paddle shafts are now being turned in the lathes, and the screw is constructed.

The paddle-boxes, and the parts adjacent to them, are being arranged, and their construction will be immediately commenced.

Some of the decks will shortly be laid; and also some of the cabins, the arrangements for which have been already settled, will be put together.

The timbers for the internal fittings are being prepared by a process for rendering them uninflammable.

The arrangements for launching are now being taken into consideration, and trial borings are being made on the river front of the building yard, with a view to ascertain the nature of the ground, and thus determining the extent of work necessary for ensuring solid ways whereon the cradles, with their immense burden may, with perfect safety, slide; for it is now ascertained that the weight at the launch will be between eleven and twelve thousand tons, which includes all the machinery, boilers, rigging, &c.; in fact, she will then be fit for sea, and with that weight she will draw between 15 and 16 ft. of water. It is satisfactory to be able to state that the borings are good, showing a perfect bottom at 35 feet, capable of sustaining, with perfect safety, a load of more than twice that which will have to be borne.

The maximum weight per square foot, which the ways will have to sustain, will not exceed one ton.

WESTMINSTER BRIDGE.

Whatever reproaches may have been made against the public buildings of London, our bridges across the Thames have always been the admiration of artists and foreigners.

Waterloo Bridge was pronounced by that great artist, Canova, to be the finest work of its kind. Southwark and London have been admired for their boldness, simplicity, and scientific construction; but Blackfriars and Westminster, which were formerly the boast of the metropolis, are now a disgrace.

Our attention to this latter structure, namely, Westminster Bridge, has been attracted recently by articles in the "Spectator," "The Times," and "The Builder," upon the proposed Iron Bridge, and which have since excited much interest. We therefore think it our duty to lay before our readers some facts connected with the building of the old bridge; and also with reference to the commencement, and the stoppage, of the works of the new one. The old bridge was designed and executed by C. Labelye, a Swiss engineer, and was commenced in the year 1730. The mode adopted for laying the foundations in the bed of the river, was with caissons, and without piles (instead of coffer-dams with piles): it was denounced publicly at that time by the most experienced engineers and architects as dangerous and contrary to their experience; and this error of construction was subsequently proved by the settlement of two of the piers of that bridge in 1750, only twelve years after the commencement of the works; and those piers were obliged to be taken down and rebuilt, thus demonstrating the unsuitability of the caisson system of forming foundations under such or similar circumstances.

Nevertheless, the bridge stood very well until the removal of old London Bridge, when the increased scour of the tide, occasioned thereby, washed away and undermined its foundations, so as to cause a considerable settlement in several of the piers and arches, the repairs of which, from 1810 to 1844, according to the parliamentary returns, amounted to £190,211 15s. 9½d., a sum literally thrown away. Whether this wasteful expenditure should be charged to mismanagement, or entirely to the defective nature of the original structure, we do not here pretend to say. Its result, however, was the appointment of a committee in 1844, which, after examining competent witnesses, recommended the removal of the old bridge, and the rebuilding of a new bridge on the same site. Committee after committee sat, until at last, in the year 1853, a committee decided to build an iron bridge.

In 1850 a committee recommended the construction of a temporary and *economical* bridge, on or near to the present site.

In 1851 a committee confirmed the recommendation as to the site, and also as to the construction of an *economical* bridge of five arches, on stone piers, the head-way to be 25 ft. above Trinity high-water mark, and the width to be 60 ft.

The proceedings of the committee of 1853, are given without any report or comment, but a plan was deposited in the library of the House of Commons, unaccompanied by any detailed drawings, showing the manner of constructing the piers and the work generally. Neither was the mode of constructing the piers and the bridge, (although novel,) brought fully to the notice of the committee, as will appear by the following extracts from the evidence of Mr. Page, in 1853.

In *question* 74, in answer to Mr. Clark, Mr. Page stated that there was no special design made out for the present bridge beyond the *diagram* shown. *Q.* 75. Then there is no design made for the bridge?—*A.* No. *Q.* 76. Is there any estimate?—*A.* Yes. *Q.* 77. How can that be when you say there has been no design made for the bridge?—*A.* An estimate can very easily be made without going into an architectural design, by taking the cost of other bridges of similar span and width. Again, when asked about the construction of the bridge, the answer was,—"I am not *instructed* by the Chief Commissioner to state what the details would be, or what course he will take in future."

Again, in answer to question 109, the witness says,—"Considering the *circumstances* under which I came here, and having stated that only a *section* had been made, I do not think it quite fair that you should enter into *all the particulars* of the *construction of the bridge.*"

In looking through the continuation of the evidence, we do not find anything more satisfactory on the point, or, (so far as we can judge,) that anything more was determined upon by the engineer, who seems to have been acting under the orders of the Chief Commissioner of Works,—viz., "to construct a *cheap* bridge," as recommended by various committees: he was, therefore, appointed to make the necessary drawings, &c., for contracts.

It will be remembered by most of our readers that three tenders were sent in; the lowest, that of Messrs. C. T. Mare and Co., was eventually accepted at £206,438, being some £100,000 below the highest offer—"for the construction of the new bridge; the maintenance of the "old bridge meanwhile; and the removal of all the materials of the old "bridge which shall not have been used in the new." The sum added in the estimate for contingencies brings the total cost of the structure up to £235,000.

The quantity of the bridge estate which was to be sold would, it was expected, produce nearly the amount, but there might be a deficiency of £25,000, to be provided by Parliament. The bridge was to occupy nearly the site of the old one; but it was ultimately determined that the width should be increased to 85 ft., nearly double the width of the present bridge. The new bridge was designed with seven arches, and to be 827 ft. in length, with a water-way of 755 ft.; the head-way under the centre arch at Trinity high-water being only 20 ft., and not 25 ft. as recommended by the committee of 1851.

The mode of constructing the foundations and piers of the bridge is sufficiently detailed in the report of Mr. Page, and of Messrs. Rendell and Simpson, as to render a description of that compound contrivance unnecessary. Suffice it to say, that we have never seen any piers composed of such a variety of materials.

Such being the nature of the construction of the bridge proposed to be built by Mr Page, it became necessary, after the unfortunate failure of Messrs. Mare & Co., to investigate how far the nature of these works was consistent with the stability and permanency required for a metropolitan bridge. This the chief minister of public works undertook upon his own responsibility, by calling in the aid of Messrs. Rendell and Simpson, and by the appointment of a select committee of the House of Commons to hear evidence on the subject. The result has been the publication of the evidence, and a report, in which it is stated that the amount of liabilities incurred for works connected with the new bridge was £85,009; that the completion of the first section will demand 18 months from the time of active resumption of the works; that the completion of the second section cannot be estimated at less than four years from the opening of the first section; that the cost of completing it cannot be estimated at less than £200,000, and that the probable cost of suitable approaches will be £384,800, say a total of £585,000; and it is added that the original scheme is defective in many of its details, more especially in the construction of the piers below low water.

The committee further state "they are satisfied that the proposed "piers are of *strength amply sufficient to bear the weight proposed to be* "*placed upon them;* that the piers will be secure so long as the iron "castings remain sound; that the iron castings can be replaced when-"ever it may decay or be destroyed, but that such a mode of construc-"tion *is less* permanent and secure than granite piers founded deep on "the London clay by means of coffer-dams.

We therefore hope, now that the war is over, there will no longer be any excuse for erecting a *cheap* bridge, but that a new bridge will be made—a permanent, solid, and beautiful structure, such as London, Southwark, and Waterloo bridges, with piers and arches of granite; and founded, like those bridges, on piles driven into the London clay, and by means of coffer-dams.

On referring back to the "Blue Book" for 1846, on Westminster Bridge, we find that such a bridge, of stone, according to the evidence and agreeably to the design of Mr. George Rennie, would cost about £300,000, exclusive of approaches, or little more than the proposed bridge, of the combined materials of granite, brick, concrete, cast and wrought-iron, &c., &c., and when executed would be a far more permanent structure.

On the 30th of September, the Board of Works invited by advertisement, in the public prints, a general competition to architects of all nations for the best design for New Government Offices.

No. 1 Design is to show, by a block plan, the best mode of concentrating the principal Government Offices, on a site comprised between the Thames and St. James's Park, one way; and between Great George Street, New Palace Yard, as far as Downing Street and Richmond Terrace, the other way. "The design is also to represent any improvements which the author may suggest in the principal approaches to the New Palace at Westminster, as well as in the communications with the Surrey side of the River Thames, especially with reference to the situation of the *New Westminster Bridge*, the ultimate position of which must be considered in connection with this design."

Thus it will be seen that there is an opportunity of a more advantageous position being selected for a new west-end bridge; for in its present position the New Westminster Bridge must be either sacrificed, or be entirely rebuilt in a more permanent manner.

To us, the most eligible situation seems to be about 150 to 200 ft. below the old bridge, opposite to Manchester Buildings. The bridge to be about 60 ft. in width, and built of granite.

The piers should be founded on piles driven deep into the London clay: so that any alteration in the bed of the river would not affect the foundations of the bridge. And it must not be lost sight of, that changes will be effected in the course of time by the narrowing of the river, and the various contemplated improvements, such as the embankments proposed for the Middlesex and Surrey sides.

In the situation we propose, it would be only necessary to divert about 500 ft. in length of the least valuable portion of the present Westminster Bridge road, and thus the road would be continued very much in the old line.

But we have no doubt now that the Board of Works having commenced such energetic measures to secure the best plan for the Government Offices, they will also take care that *the best* position shall be chosen for the new bridge, and that its design shall be such as will reflect no discredit on the talent and taste of the bridge-building engineers or of the public taste of the present day; whilst the material and mode of construction shall be of a thoroughly permanent and *non-composite* character,

BESSEMER'S IMPROVEMENTS IN MAKING MALLEABLE IRON, &c.

In our September number we gave a report *in extenso* of the very interesting paper read by Mr. Bessemer before Section G. at the Cheltenham meeting of the British Association, in which this important invention was, for the first time, announced to the public. We were also exclusively enabled to give an accurate report of the more interesting parts of the discussion which followed the reading of the paper. We were also the first to give an illustrated description of the converting vessel and apparatus, as used by Mr. Bessemer; and to describe the experiments made at Baxter House, for the purpose of demonstrating the practicability of the process.

During the time intervening between the first public experiment, on the 22nd of August, and the end of October, we have very frequently witnessed experiments variously made, for the purpose of testing the invention in every conceivable manner; and, with but two or three exceptions (and these resulted from inadvertence or inattention), every demonstration was successful; and, notwithstanding all that those who are either adversely interested, or ignorant of the matter may say, *the invention is in principle correct*, and all that Mr. Bessemer professed he was able to do—in the way of converting, by one operation, the crude pig iron into refined metal, fit for rolling and working into malleable iron—he *is* able to do, and does unmistakeably.

That greater experience is required in the management of the operation is undeniable; but the very failures which have arisen from the deficiency in this respect, have proved the correctness of Mr. Bessemer's principle.

We have seen some of the *burnt iron* produced by accident, during an experiment, converted into *fine fibrous iron* rods and sheets, by re-heatings and workings.

BESSEMER'S IMPROVEMENTS IN MALLEABLLE IRON AND STEEL.

FIG. 1.

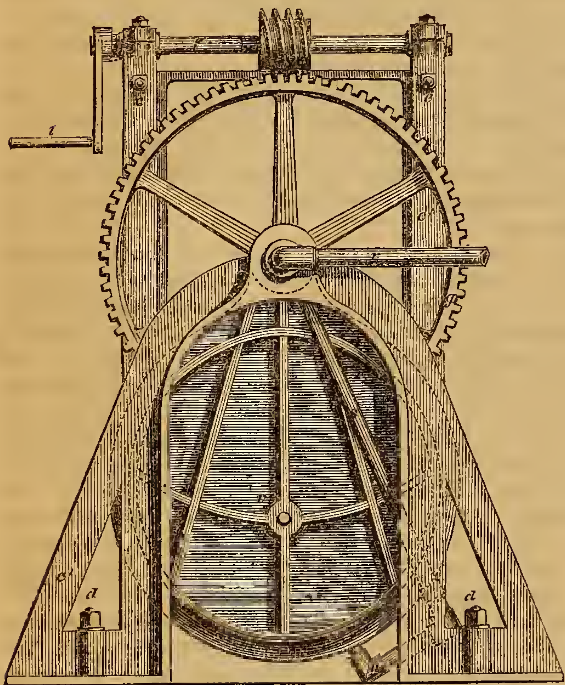


FIG. 2.

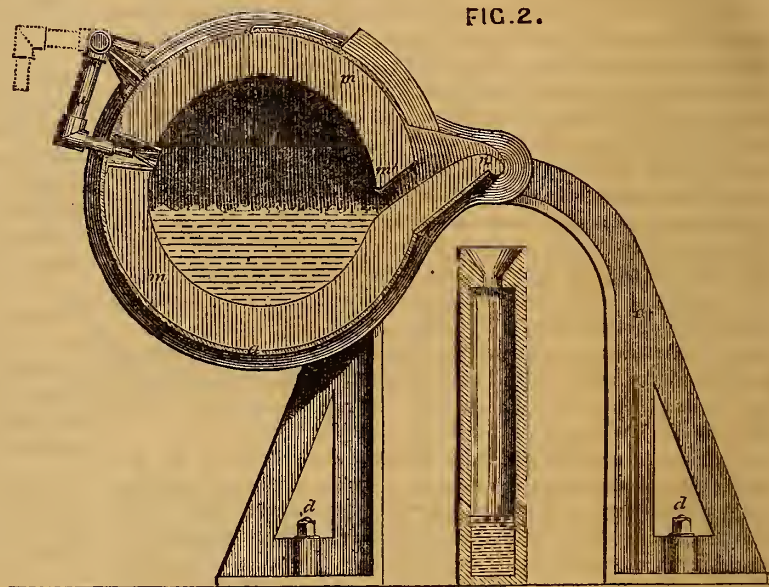


FIG. 3.

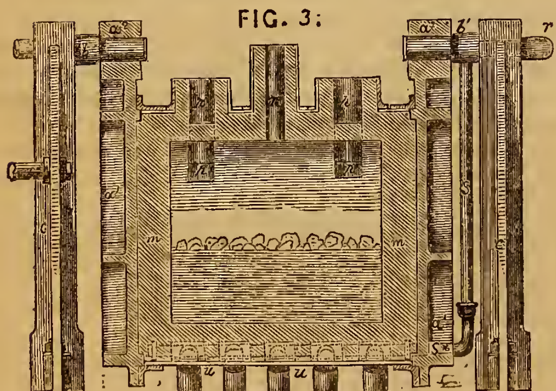


FIG. 4. FIG. 5.

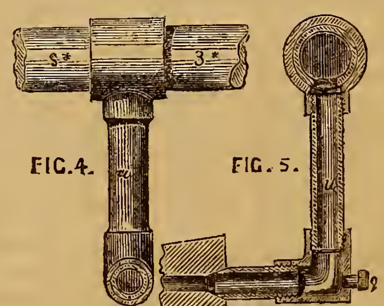
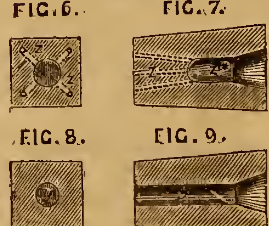


FIG. 6. FIG. 7. FIG. 8. FIG. 9.



The following is an account of experiments made under the superintendence of Messrs. Smith, Phillips, and Co., the owners of the Dafen Tin Plate Works, Llanelly:—

In the first place, the firm furnished Mr. Bessemer with a mixture of different sorts of pig iron, such as are used by them for making their best charcoal bars. This was melted in the presence of one of the firm at Baxter House, and then run into the converting vessel, and in twenty-five minutes an ingot of soft malleable iron, 10 inches square, was produced. It was so soft as, when cut with a chisel, to have almost the appearance of lead. The charge of iron being insufficient to fill the mould, a thin crust was formed at the upper end of it, and so strong was it that it required considerable exertion with a heavy sledge hammer before a small piece, about an eighth to a quarter of an inch thick, could be broken off. The 10-inch ingot being too large to be treated properly there, Mr. Bessemer had it hammered down at Woolwich into two ingots of about 4 and 5 inches square. It was evidently injured by this process, having been apparently overheated, for the two ingots broke easier than ordinary pig iron of the same size would do. This was very discouraging, but the firm determined to continue the trial. They began by heating part of an ingot in a hollow fire, and when it was at a white heat, it was reduced under a 30-hundred weight steam hammer to a slab, about 5 inches wide by 3 inches thick. This was again heated and rolled into a bar, half an inch thick, and a very wretched-looking bar it is stated to have been, being deeply cracked all down one side. Much better bars have however, since been made from part of the *same* ingot. So bad was it, that one of the firm thought it useless to proceed further with the experiment; but another member, nothing daunted, had it cut up into pieces of the usual length, and taken to the mill. It proved to be what is called in the trade very cold short, and did not cut at all well. Here, however, the difficulties ended, for it rolled beautifully into sheets, to the amazement of all who were present. The thinnest of the specimens sent (all of which were made from the unpromising looking bar above mentioned) is what is called "tagger" iron, and is unusually thin. At all events, none so thin have ever before been produced there, or at all approaching to it. It will be found, on bending it, that it is remarkably tough. The thicker piece of iron of the specimens sent has not been annealed, and therefore is not so tough; but the same iron, annealed and finished as tin plate, stands what is considered a very severe test, namely, twice doubling without cracking. The firm have reason to believe it is fully equal to plates of the same substance made from their best charcoal iron.

This experiment, and others since made, lead to the belief that, if uniform results can be obtained from the converting vessel, and if the same quality pig iron is always used, there is every reason to believe that the invention will prove very valuable to tin plate makers, as there is clear proof that sheet iron of superior quality may be produced by adopting it.

The best way of working the large ingots into bars has yet to be learnt; but it is expected that the plan Mr. Bessemer recommends, of passing them through a series of rolls, will be found to answer perfectly. It may be mentioned that Messrs. Smith, Phillips, and Co. tried a piece of the bar from which the specimens sent were rolled, in the blacksmith's shop. It proved to be very red short, and difficult to work; so that some further improvement in the process is required before iron made by it can be brought into general use.

One of the disadvantages under which Mr. Bessemer laboured in connexion with his experiment made at Baxter House was, that during the pouring of the molten metal from the converting vessel, after being refined, the air was carried into the mould with the metal, and produced very porous ingots.

To remedy this defect, which was of the greatest disadvantage in connexion with the steel or semi-steel produced by this process, Mr. Bessemer proposed a plan of pouring the metal by means of a novel contrivance, in which the same principles were involved as in his converting vessel, except that the cold air is driven *on to* the surface of, instead of *into* the midst of, the fluid metal.

Mr. Bessemer, in specifying the patent for his invention, gives the following description of the very ingenious contrivance which he has superadded to his former apparatus, and of which we now give illustrations, kindly furnished to us by Mr. Bessemer. He says :—

In carrying this invention into practical operation, it is preferred to mount the refining vessel or chamber on axes not situated at or near the centre of gravity of the chamber, by which means the pouring out of its contents will be facilitated, and the spout kept in a proper position in reference to the mould during the time of pouring the fluid metal therein. The air may be introduced at the sides or ends of the vessel, through small holes formed in pieces of well-burned fire-clay, so that by moving the chamber or vessel on its axis, the holes in the fire-clay may be made to descend beneath the surface of the metal, or be raised above it, as desired. It must be observed that the air or other gaseous matters must be compressed with a force greater than will balance the weight of a column of fluid metal of a height equal to the depth of immersion of the jets below the surface of the fluid metal.

The accompanying illustrations show the form of apparatus employed: Fig. 1 being an end elevation; Fig. 2, a cross section; and Fig. 3, a longitudinal section of the vessel or chamber. Fig. 2 shows the vessel half turned up, but in Figs. 1 and 3 it is shown in its lowest position. The tuyere pipes are also shown in detail at Figs. 4, 5, 6, 7, 8, and 9.

The cylindrical vessel *a* is formed of stout plate iron, secured by angle iron flanges to the cast-iron plates a^1, on which ribs or webs are formed, for the purpose of giving to them the requisite degree of strength. At one side of the plates a_1, and at a point beyond their outer edges, bosses are formed: they are bored out truly and fitted and keyed to the axles *b*, and b^1, on which the converting vessel *a* is made to move when required; *c, c*, are iron frames secured by bolts *d*, to the masonry foundation, on which the whole apparatus rests; the frame c^1 rises higher than the others, and has plummer blocks, *e, e*, bolted to it, in which the shaft *f* revolves; a worm wheel *g* is keyed firmly on the axis *b*, and receives motion from the worm *h*, whenever the handle *i* and shaft *f* are moved round. The interior of the vessel *a* is lined with fire-bricks or fire-stone (as shown at *m*), or it may be lined with any other slow conductor of heat capable of withstanding the high temperature and solvent action of the slags, to which the lining is exposed when the vessel is in use, the bricks or fire-stone may, however, be protected and mended from time to time by removing either of the said plates a^1, which may again be bolted on to the vessel as soon as the new lining is completed, or a man-hole (not shown in the drawings) may be made in one side of the vessel, through which the lining or repairs may be effected without removing the end of the vessel. At *n* there is formed a projecting spout or lip, for the purpose of running out the fluid metal; this lip is made to project from the vessel so far as to bring it in a line with the axis, so that into whatever position the vessel *a* may be moved, the extremity of the lip *n* may retain the same position, or nearly so, and thus allow the stream of metal flowing over it to fall into the ingot mould, which would not be the case if the axis were placed in a line with the centre of the cylindrical vessel; by reference to Fig. 2, it will be seen that at m^1 the lining is formed so as to prevent the metal from carrying out with it the slags or other matters, floating on its surface until after the metal has run out. On each side of the spout *n* (see Fig. 3) there is a curved passage *p*, by means of which the flame and gaseous products evolved during the process may escape, but the splashes of metal thrown up by the jets of air are for the most part prevented from escaping from the vessel by the serpentine form of these outlets. At *r* there is a pipe, which is made to communicate with a blast engine, or with a steam-boiler, or it may be made to communicate with a reservoir containing oxygen gas, or a mixture of oxygen with other gaseous fluids, or with any gaseous matter capable of evolving oxygen, any or all of which may be used, either in a cold or heated state, although it is preferred to use atmospheric air at its natural temperature, on account of its cheapness and efficiency. The pipe *r* is fitted at one end to the trunnion or axis b^1, which is made hollow, and is provided with a stuffing-box or other joint, so as to allow the movement of the axis without interfering with the passage of the air; through it the pipe *s* is also connected with the hollow axis b^1, and has a right angled elbow or bend at its opposite end, and then continues along the outside of the vessel throughout its whole length, and is turned truly on its exterior surface, and has fitted upon it several small branch pipes, *u*, each of which has a T-piece connected to them, which, bored out truly, and made to fit accurately to the exterior of the pipe *s*, so as to admit of the pipe *u* being moved on the pipe *s*, into the position shown by dots in Fig. 2. Along one side of the converting vessel there is a row of square holes, in which small blocks of well-burnt fire-clay are loosely fitted; they are held in position by ramming a little loam well into the joint formed between them and the lining *m*. At one end of these blocks or tuyeres the pipe *u* is fitted by a simple cone joint, the other ends of the tuyere-blocks have several small holes made in them, leading into one larger passage, which communicates with the pipe *u*, so that a communication is thus established between numerous points of the interior surface of the converting vessel, and the blast-engine, or reservoir of gaseous matters before referred to, and by means of which numerous small jets or currents of air, &c., may be forced into the converting vessel when required; a sluice-cock on the pipe *r* (not shown in the drawings) enabling the workmen to turn off the supply of air when required. In order that the way in which the pipe *s* and the pipe *u* are arranged may be better understood, a detached view of them is given at Figs. 5 and 6, where it will be seen that the pipe *s* has a hole in it at *x*, which is opposite the orifice of the pipe *u*. Through this hole the air may pass freely when the pipes *u* occupy their ordinary positions; but whenever any of the tuyere-blocks require renewing, the pipe *u* can be turned upon the joint formed at its union with the pipe *s*, as shown by dots in Fig. 2, and in which position the hole *x* in the pipe *s* will be closed, while free access to the tuyere is obtained. Also at Fig. 6 is shown an end view, and at Fig. 7 a longitudinal section of a tuyere block, where *z, z*, show the small apertures through which the air escapes into the metal, all of which passages unite in the larger one *z*, the orifice of which is made conical, so as to fit the end of the pipes *u*. It has also been found that a single outlet in each tuyere-block will answer well in practice, as represented in end elevation at Fig. 8, and in longitudinal section at Fig. 9, where a single parallel passage *y* leads direct from the pipe *u* into the metal. As these passages sometimes get obstructed, a screw plug *q* is fitted at the back of the elbow of the pipe *u*, which plug may be removed, if required, while the apparatus is in use, and a steel rod introduced at the aperture, which should be thrust entirely through the tuyere-block, and any accidental accumulation of matter will be thus removed. By reference to Fig. 1, it will be seen that a boss *v* is formed at the point of junction of two of the webs which are formed on the end plates *a*, of the converting vessel; into this boss a stud is fixed, to which a chain or tension rod may be attached for the purpose of suspending a counter-balance weight, the chain passing over a pulley, supported by the roof or other convenient part of the building, so that the vessel *a* may be the more easily moved on its axis by means of the worm-wheel gearing before described.

Bessemer's process has been adopted at some of the largest iron works in England and Wales, and we have seen splendid specimens of iron and articles made therefrom in numerous forms, from a 22 ft. long single-headed railway bar to batten and tagger plates, so thin that four thicknesses will pass readily into the No. 26 iron wire gauge, or of the thickness of a sheet of ordinary writing paper.

We shall again recur to the subject next month, when we hope to be able to give the results of some very important and practical workings on a large scale, which are now being made.

CAPTAIN UCHATIUS'S NEW PROCESS FOR THE MANUFACTURE OF STEEL.

For the satisfaction of a number of scientific gentlemen, engineers, and others interested in the subject, an exhibition of the new method of manufacturing steel, the discovery of Capt. Uchatius (Engineer in Chief of the Imperial Arsenal at Vienna), was made on Saturday, October 11th, at Messrs. Rennie and Sons, the Albion Engine Works, Holland-street, Blackfriars-road.

Mr. Charles Lenz, the partner of Capt. Uchatius, operated on the occasion, assisted by workmen from the factory of Messrs. Turton and Co., at Sheffield. Whilst the process was going on, Mr. Lenz read a paper descriptive of the invention. He commenced by explaining that he had laboured under many disadvantages in being compelled to contrive substitutes for the regular furnaces and other proper appliances peculiar to steel works, but, nevertheless, an opinion could be there formed of the merits of this important invention, for all the melting operations in cast steel manufacture were necessarily a series of operations on a small scale, the size of a steel crucible limiting the magnitude of the furnaces. He proceeded to state that the method adopted in England, and all over the world, he might say, for making the best descriptions of cast steel heretofore, was to convert Swedish or Russian bar iron, by a lengthy, uncertain, and costly process, first into what is called blister steel, which product was then melted down in crucibles and cast into ingots for the manufacture of the bar steel of commerce. The invention about to be exhibited by him would render this country quite independent of Sweden and Russia for steel iron-making, as he would show the company present that East India pig iron, now very plentiful and cheap here, could be converted into fine steel in as few hours as Swedish and Russian bar iron would take weeks to manipulate; in addition to which, he could assure those present that numerous descriptions of ordinary English pig iron would answer for this process equally well, if he might judge from the limited experiments in English iron, he had performed. Indeed, the results of these experiments were very remarkable, and he expected that nearly all the ironworks would soon make steel as regularly as they now made iron. He begged the company to consider the importance of a discovery which would so reduce the cost of steel as to render it available for numerous purposes in engineering, now quite precluded by the price; he did not hesitate to assert that fully two-thirds might be saved in the cost of producing cast steel by using the present instead of the old process. Mr. Lenz then proceeded to explain that the invention of Capt. Uchatius was founded upon the well-known fact that cast iron surrounded by any oxygenised materials, and subjected to a cementing heat for a given time, would yield up a portion of its carbon, which would combine with the oxygen driven off from the surrounding materials, forming carbonic oxide or carbonic acid gas. If this process were interrupted before completion, a partially decarbonised iron would result, the surface of which would have been converted into a pure iron, while the inner parts remained unchanged; or, in other words, the progress of the decarbonising action would depend on the amount of metallic surface brought into contact with the oxygen-yielding material with which the iron was surrounded. In order, therefore, to expedite this operation, the pig iron was first reduced to a granulated state, which was accomplished by simply running the molten iron from the cupola (a blast furnace in some cases) into cold water, agitated by mechanical means. This granulated iron was mixed with a proper proportion of pulverised oxygen-yielding materials of a very cheap description, such as sparry iron ore (spathose ore), and adding, if requisite, a small quantity of manganese, which mixture was put into common crucibles and subjected to heat in a cast-steel blast furnace of ordinary construction. By thus subjecting the granules of iron, in presence of the sparry iron ore, to a melting heat, the surrounding oxides would first effect a partial decarbonisation of the granulated iron, which decarbonisation would be limited in amount according to the size of the granules operated upon, and by reason of the continued application of heat the iron would melt and separate (with the assistance of the melting residue of sparry iron ore) from the impurities with which it was mixed, and also bring down with it a portion of the iron contained in the sparry iron ore, thereby increasing the yield of cast-steel by about 6 per cent. The manipulations of melting and casting were the same as those commonly employed by cast-steel manufacturers. The quality of the steel made by this process could be considerably modified. Thus, the finer the pig iron was granulated, the softer would be the steel made therefrom. The softer sorts of welding cast-steel might be obtained by an addition of good wrought iron in small pieces, and the harder qualities by adding charcoal in various proportions to the before-mentioned mixture. Thus, continued Mr. Lenz, might crude iron be converted into steel ingots in the incredibly short space of about two hours.

Mr. Lenz then proceeded to exhibit the preliminary process of granulating, by running a crucible of melted pig iron into a vessel of water, when it was instantaneously converted into shot-like particles. A weight of 24 lbs. of the granulated iron was mixed with 6 lbs. of crushed ore and peroxide of manganese, in the proportion, it was said, of about 4 lbs. of ore and 2 lbs. of peroxide of manganese, to which was added a small quantity of fire-clay, and filled into the crucible in the temporary furnace, and allowed to melt in the usual manner. In the mean time the company proceeded to witness the operation of the hammering down into a bar of an ingot of this new steel, which had been made a few days since, and although the steam-hammer used was not at all adapted for steel, nevertheless, the bar steel produced from the ingot then hammered was pronounced to be of excellent quality, and tools made by Messrs. Rennie, from a fellow ingot, were tried and found to possess the qualities of fine English cast steel. After two hours and three quarters had elapsed since the filling—some defect in the blast a little retarding the melting—the contents of the crucible were poured into the iron mould, from which, when opened, an ingot of steel, weighing 25 lbs., being 1 lb. more than the iron used, was exhibited to the company, which bore every external evidence of being perfect in quality. It was to be forwarded to the steel works of Messrs. Spencer and Sons, of Newcastle-on-Tyne, to be properly tilted into bar steel for further tests as to its quality and properties. The simplicity and rapidity of the new process, as well as the quality of the specimens of steel shown, elicited much admiration. The importance of the process in reducing the cost of steel can scarcely be overrated when the innumerable new uses to which it would inevitably be turned in preference to iron are considered—the expense of steel tyres, axles, piston rods, shafts, and other important working parts of machinery being estimated as not exceeding the price now paid for first-class iron.

THE HYDROMETER.

By an Engineer, U. S. Navy.

The hydrometer is an instrument used for the purpose of determining the specific gravities of liquids, and when applied to the water of marine boilers, indicates the amount of saline or solid matter which it contains; and upon the indications of this instrument the marine engineer relies entirely for the quantity of water which he causes from time to time to be ejected from the boiler. The proper graduation of the hydrometer is, therefore, a desideratum which none will deny; for should it, on the one hand, indicate the amount of saline matter contained in the water to be less than it really does contain, the result will be an unsafe amount of deposit, endangering the burning of the crowns and other highly-heated surfaces, to say nothing of the loss of fuel by this non-conducting substance preventing the heat from passing freely into the water. If, on the other hand, the instrument represents the water to be salter than it really is, more water will be blown off than is necessary to keep the water in the boiler below the density at which any serious deposit would take place, occasioning an unnecessary loss of fuel. Hence the importance of having these instruments accurately and reliably made; but if they be graduated according to the *modus operandi* furnished by W. H. Pile, M.D., we should not like to rely upon them to govern us in the blowing-off process.

This writer, in the September number of the "Journal of the Franklin Institute," page 187, speaking of an instrument manufactured in New York, says:—

"A very slight observation was sufficient to convince me that *that particular scale, at least*, was quite unfit to give correct results; however, by comparing it with an instrument made in Glasgow, * * * * I find the scale is intended to indicate, not the number of ozs. per gallon, but the proportion of salt or saline ingredients in a quart, or 32 ozs., of water. Thus, 1 oz. of salt in a quart of water is marked $\frac{1}{32}$, 2 ozs. in a quart of water $\frac{2}{32}$, &c.

"It now became comparatively easy, by making solutions of dry salt in water of these various proportions, to ascertain their actual specific gravity. This I have done with care, both by delicate hydrometers showing specific gravity, and also by the specific gravity bottle.

* * * * *

"As the specific gravity of the various saline substances in sea water is very nearly the same as that of salt itself, the results will not differ sensibly, whether we consider the scale of the salinometer as indicating the proportion of all the salts contained in sea water, or as showing that of pure salt only, in a solution of that substance in pure water."

We have presented to us, in the above extracts, first, "that *that particular scale, at least*, was quite unfit to give correct results," and, secondly, that the instrument *is* intended to indicate "the proportion of salt or saline ingredients in a quart, or 32 ozs. of water." We are not informed whether it did or did not indicate such a proportion, only that "*it is intended*" to do so, but it matters but little from what follows; for it appears that the scales of the instruments manufactured by W. H. Pile, M.D., were graduated by dissolving common salt or chlorid of sodium in fresh water, in the proportion of one, two, three, &c., parts of salt to 32 parts of water, by weight, and from this he kindly furnishes, for the information of the unlearned, a table of the specific gravities of these mixtures, and advances the very wonderful truism, that "the specific gravity of the various substances in sea water is very nearly the same as that of salt itself." The grounds upon which we have this conclusion relative to the specific gravities of pure chlorid of sodium and the solid matter of sea water, are not given, the fact being left entirely to the credulity of the reader. We, however, assume the liberty to differ from this opinion, and to advance the contrary, that the specific gravity of chlorid of sodium and the solid matter of sea water not only differ, but that the specific gravity of this matter itself differs for different localities, consequent upon being compounded of differently proportioned ingredients. Any hydrometer, therefore, having a scale attached graduated to show the proportion of pure salt in a mixture of salt and fresh water will not indicate correctly the proportion of saline matter in sea water. Any one can satisfy himself on this point by trying the experiment.

So much for Dr. Pile's experiments, which, otherwise than they might mislead some one in the manufacture of these instruments, would require no notice at our hand. In the manufacture of hydrometers there is one thing, however, which is required, and that one is, that the scale be secured in such manner that it cannot shift its position. Practically, sealing-wax is found not sufficient to keep the scale in its true position, after being used for a considerable time in hot water, and the cement of some manufacturers is not much better, though there are many who pay more attention to this important point. Extending the paper, or whatever the scale may be marked upon, down, so as to rest on the bottom of the instrument, would be, we think, a very good plan to prevent it from slipping.

Now, then, a word about blowing off. The scales of most of the hydrometers used on board of American steamers being graduated to indicate the proportion of solid matter in 32 parts of water by weight, it is usual to assume the density of the water entering the boiler to be $\frac{1}{32}$, *i.e.* containing 1 part of solid matter in 32 parts of water, and to make the calculations on the loss by blowing off accordingly; but as the density of sea-water varies very widely for different localities—the solid matter contained therein varying from ·66 to 38·5 per cent. of the weight of the mixture—such calculations cannot be applicable to all localities. For instance, supposing the feed water entering the boiler instead of being $\frac{1}{32}$ to be $\frac{2}{32}$, and the water in the boiler to be maintained at $\frac{3}{32}$, and the loss by blowing off calculated in the usual way (assuming the water to enter at $\frac{1}{32}$) to be ascertained to be a certain per cent., the actual loss must be much greater, because instead of, as assumed, there being 2 parts of water converted into steam, and 1 part blown off, there will be only ·5 part converted into steam if the part blown off be considered 1.

We will illustrate this by an example:—steam, corresponding in elastic force to 42·34 inches of mercury; water maintained in the boiler at $\frac{3}{32}$; temperature of the feed water, 100° Fah.

At this pressure the sensible heat of steam, according to Regnault, is 230° Fah., and the total heat, 1184° Fah.; and, assuming the water to enter the boiler at $\frac{1}{32}$, we have—

1184° = Total heat.	
100° = Tem. of feed water.	230° = Tem. of the water blown off.
1084°	100° = " feed water.
2	130° = Heat required of the fuel for 1 part of water which is blown off.
2168° = Heat required of the fuel to evaporate 2 parts of water.	

∴ 2168° + 130° : 130° : : 100 : 5·66 per cent. loss; but if the water entered the boiler at the density of $\frac{2}{32}$, we would have—

1184° = Total heat.	
100° = Tem. of feed water.	230° = Tem. of the water blown off.
1084°	100° = " feed water.
·5	130° = Heat required of the fuel for 1 part of water which is blown off.
542·0° = Heat required of the fuel to evaporate ·5 part of water.	

∴ 542° + 130° : 130° : : 100 : 19·34 per cent. loss, showing a very wide difference in the results; and hence the importance of knowing the precise density of the feed water as well as the density at which the water is maintained in the boiler before making such calculations.

THE LATE BOILER EXPLOSION AT HAMPSON MILL, BURY.

At an adjourned inquest on the body of one of the sufferers by this explosion,* Mr. Roberts, C.E., of Manchester, was examined, who, at the request of the jury, had made an inspection of the boiler plates, and prepared a report relative to the probable cause of the accident. He read his report, and we give that portion of it which specially bears upon the cause of the disaster:—

"It appears to have been discovered since the accident occurred that the brickwork which supported the right-hand side of the boiler having been built against a rock, from which water issues, must have been kept in a continually damp state; and the plates, the corrosion of which corresponds with the brickwork seating, must have been caused by that moisture; nor could the wasting of the plates be detected without taking down the brickwork, or sounding the boiler from the inside. I once took down a boiler, which had been in use about eighteen years, without showing any material indications of wear, when, to my great astonishment, I discovered that a portion of one side of it, where it had been in contact with the brickwork, was reduced to one fiftieth of an inch in thickness, and must have been prevented from bursting by the weight of the boiler being greater than the pressure of steam acting against the thin portion of the plates; and I am convinced that in the present instance no blame is attributable either to the proprietors or the engineer, as they could not be aware of the reduced thickness of the plates. In conclusion, I would urge, that it is of the utmost importance for the security of this class of boilers, that means should be taken to keep the tubes cylindrical, that they may not collapse."

Mr. Roberts, in answer to questions proposed, stated that the flue of the boiler was not collapsed. He also expressed an opinion against the use of long boilers, and said that it would have been better if the boiler had been repaired by a boiler maker instead of by the men employed at the works. Millboard, or anything that would absorb water, was unfit to be used in the repairing of boilers. He considered it very desirable that boilers should be examined about twice a year.—A verdict of "Accidental death" was returned.

* See The Artizan, Oct. 1, p. 236.

EXPLOSION OF A LOCOMOTIVE, NEAR DARLINGTON.

There has been an explosion attended with loss of life at the works of Messrs. Bolckow and Vaughan, at Middlesborough. The following is the material portion of the evidence taken at the inquest:—

John Sidney Hall, foreman to Messrs. Bolckow and Vaughan, said—Mr. Williamson (one of the deceased) was the engineering draughtsman, and it was his duty to attend to the testing of engines. The engine that burst was completed a fortnight ago, and had been running upwards of a week. He made one trial of her strength last Tuesday week, but I do not know what amount of pressure he used. The engine was regularly at work in the yard, moving ironstone and other things. Mr. Williamson looked after her now and then, to see how she did her work, and finding something the matter with her, he had her put into the shop again on Saturday night. I believe she had done her work well and efficiently. A leakage in the top of the boiler was discovered on Tuesday week. She was at work at the time, and continued to work all the week in the same state. I drew Mr. Williamson's attention to this, and we agreed that she should be brought in on Saturday night to be examined. When she was examined, it was found that she leaked at two seams, in two or three places. We caulked up the joints, and the heads being off one or two rivets inside, we drew them out, and tapped copper screws into their places. The other three deceased were ordinary workmen. I was in the shop twenty minutes before the accident occurred on Thursday. They were then getting the steam up, and it was about two o'clock. I cannot give an opinion as to the cause of the explosion. I have examined the boiler since the accident, and cannot account for it. There was a man who did not like the appearance of the engine, and went away, and a boy followed him. I did not apprehend any danger from this engine, unless they went to an extreme pressure. There was a seam going along the top, which rather weakened the boiler, the bolts not holding it so firmly as the solid metal would. The boiler was weaker at the top than it ought to have been. There should have been a solid plate instead of rivets along the top. Holes were drilled to fasten the saddle on. This was quite a new feature to me, and I believe it was Mr. Williamson's own invention. I pointed out to him that she must be weaker in consequence of this seam, but he said she could easily carry 200 lbs. to the sq. in.; the usual working pressure being 80 lbs. to 90 lbs. I did not tell Mr. Vaughan this; I had nothing to do with the boiler-making department. The explosion occurred about half-past two o'clock, and shortly after three I noticed how the gauge stood. The gauge could not have been altered by the explosion, as it works upon a screw. It must have been moved by hand, if at all. I found the two gauges standing, one at 89 and the other at 130. The steam would blow off at 89, and could not get up to 130. The gauge might have been altered by some one after the explosion for anything I know; if it had not been altered the pressure was only 89 lbs. I think the engine could have been worked with safety up to 100 lbs. to the in.; and it was going at from 80 lbs. to 90 lbs. during the week. There was no occasion for a higher pressure than 80 lbs. to do the ordinary work. Mr. Williamson had the entire charge of the engineering department. The men seem to have been killed by the steam and by the plates.

Aaron Shore. I am a boiler-maker. I was in the boiler-yard, a short distance away, at the time of the explosion. I had been working at the engine during the morning—caulking and putting in studs. I put 28 copper studs, in lieu of rivets, along the top of the steam-way, or saddle. I should think copper studs are stronger than iron bolts.—The Coroner (to witness). Did you go away because you saw danger?—Witness. I was always afraid of steam, and as I had nothing particular to do there, I went away. I did not go to the place after the explosion. Before going away I asked how high the pressure was, and one of the men told me it was about 108 lbs. to the in. When I went to work on Monday morning I found the saddle sprung the sixteenth of an in., and the heads of the rivets could not help being off. They must have been forced off by the high pressure in trying the strength of the boiler.

Mr. Alfred Hill, draughtsman in the office of Mr. Williamson, said, after one or two rivets were replaced, the test was applied, and as there was still a leakage, other rivets were taken out and copper bolts put in. I think the pressure of 130 lbs. might force the rivet heads. After so many copper bolts had been put in, I doubt very much whether the boiler would bear 110 lbs. or more, but my experience does not warrant me in giving an opinion.

There being no further evidence to take except that of the injured persons, and the Coroner considering the evidence in a very defective state, the inquiry was adjourned.

A. P. HOW'S PATENT PUMP AND FIRE-ENGINE.

Fig. 1 represents a sectional elevation of pumps.

Fig. 2 represents transverse section of ditto.

A, is a cast-iron or brass suction chamber, serving also as foundation for the pumps. This chamber, A, has four apertures, B, B, C, C; the two latter, C, C, join valve cocks, D, D, which are so constructed as to act as stop valves; the wheels, E, E, being used for lowering the spindles, F, F, on to the valves, G, the spindles, F, F, having recesses, H, cast in them, which allow the stem of the valves to rise when the wheels, E, E, are used for screwing the spindles up, or effectually closing the valves when the spindles are screwed down. The aforesaid cocks have two branches, I and K; the one, I, to be used as suction for fire-engine, the other, K, for suction from the sea, or any other part it may be necessary to draw water from. L, L, are the pump chambers fitted with pistons, M, M. N is the under suction chamber, fitted with an india rubber valve, O forming the communication between the suction chamber, A, and the pumps, L, L. P shows the passage for the water from the suction chamber, A, to the upper suction valve, Q, where it flows through the passages, R, R, to the top of the pistons, M, M; S, S, are also water passages from the suction chamber to the under side of the pump pistons, M, M. T, T, are the delivering valves, having recesses, U, U, in them, allowing the stems of the suction valve, Q, Q, to rise in them, thus acting as guides. V is the delivery valve box, having branches, W, on it, to which may be attached the delivery pipes or fire-hose, as may be required. The cap, X, of the valve box, V, is also fitted with a recess, in which the stem of the delivering valve, T, rises, thus acting as a guide for both the delivering and suction valves. Y, Y, are logs cast on the delivery valve box, for taking the standard which carries the beam for working the pumps; this beam being connected by side rods to the piston rods, Z, Z, handles with sockets, that may be shipped or unshipped from the aforesaid beam, as the work requires more or less power, being provided for that purpose.

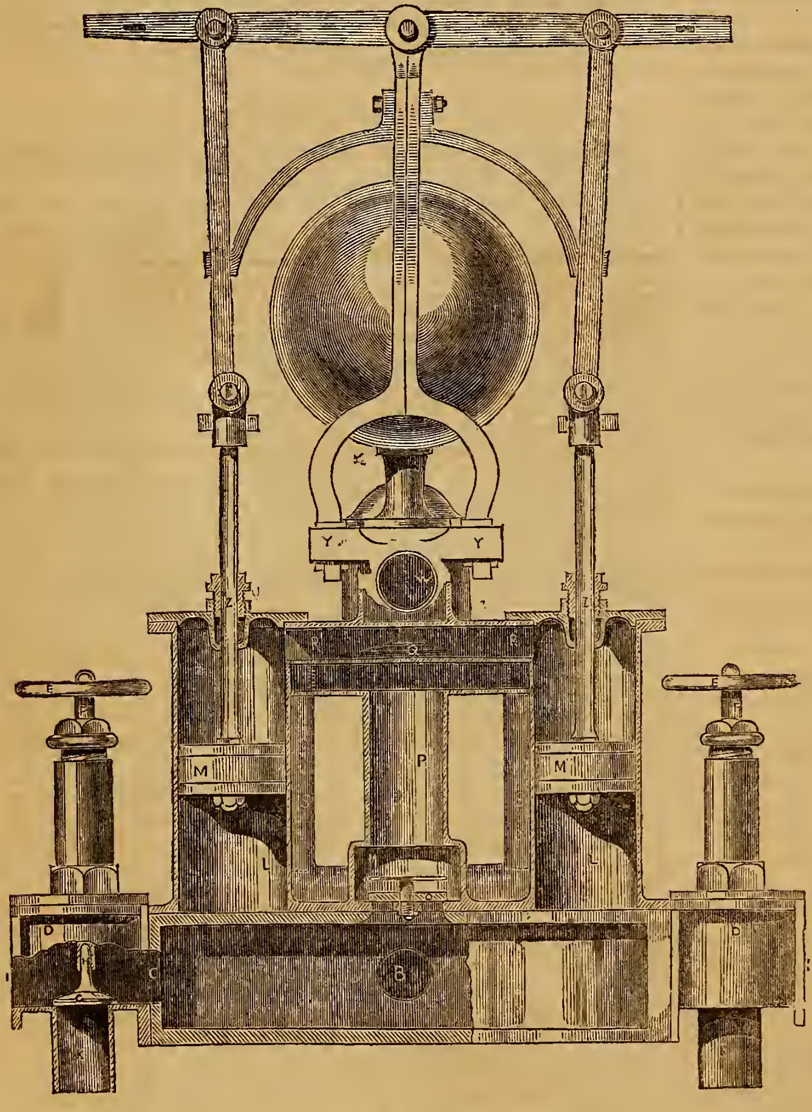


Fig. 1.

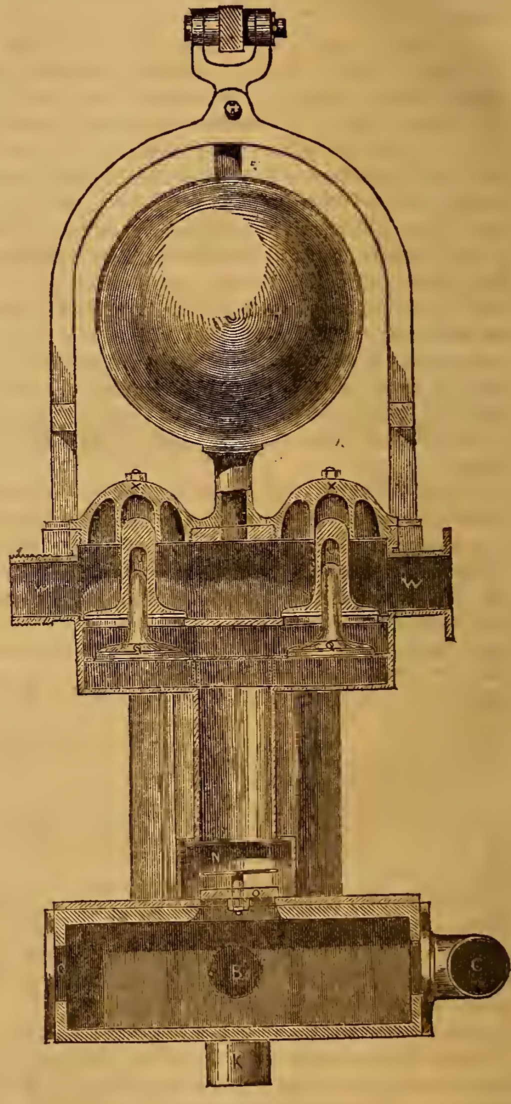


Fig. 2.

The following is a description of the action of the pump. Either of the openings, B, B, or C, C, of the suction chamber being opened, and the pump set to work, suppose that one of the pistons, M, is going down, the other going up, the water flows through the india rubber valve, O, into the passage, P, raises the upper suction valve, Q, thence goes through the passage, R, to the top of the pump piston, M, at the same time the pump chamber under the piston being full of water, delivery takes place through the passage, R, to the top of the upper suction valve, Q; raises the delivery valve, T, and is forced out of one of the delivery branches, W. At the same time the other pump piston going, the pump chamber having filled on the top of piston by the up stroke of the other one, the delivery takes place through the passage, R, above the upper suction valve, Q; the suction taking place under the piston through the valve, O, thence proceeding through the passage, P, lifting the upper suction valve, Q, and passing through the passage, S. The operation is thus continuous, and the delivery takes place twice at each up, and the same at each down, stroke.

Mr. How claims the following advantages for his invention:—

First. The mechanical arrangement of the pumps, valves, and passages; each pump being double-acting, by the disposition of the passages as described above, thus having two double-acting pumps occupying but little more room than a single-acting one of the ordinary construction.

Secondly. The simplicity of construction and detail; the suction chamber forming the foundation being cast in one piece, either of brass or cast iron; the pump chambers, suction, and delivery passages, being also one casting; the facility with which the valves may be examined, only requiring the cap to be unscrewed from the valve box, the valves being under immediate inspection, as they are placed at the top.

Thirdly. The durability, and at the same time simplicity, of this pump, is shown in the fact of only five valves being required, thereby causing a great saving in weight of material and cost of workmanship. For vessels it is invaluable, on account of the great power it possesses for throwing a large volume of water with great rapidity in case of fire, and the small space it occupies.

Fourthly. The advantages are just as great when applied to land fire engines, for which it is equally well adapted.

THE SCREW PROPELLER EXPERIMENTS ON THE "FLYING FISH."

The interesting and valuable experiments which have been going on for some time on H.M.S. *Flying Fish* (Commander Dew), which is about 900 tons measurement, and 350 nominal H.P., and constructed on beautiful lines, have now terminated. When first tried (May 13th), she had on a common screw of 11 ft. diameter, and 21 ft. 4 in. pitch, which gave her a speed of 11½ knots, with 82 revolutions of engines. This result not being considered satisfactory, such alterations were made as to get in a 13 ft. 2 in. screw, with 20 ft. pitch, which gave her a speed of fully 11½ knots with 75 revolutions, and when reduced to half power (60 revolutions) 10 knots. The Lords of the Admiralty having ordered a Griffiths screw for her and the gun-boat *Bullfinch*, Mr. Griffiths requested to be allowed to supply these screws with an extra set of blades, constructed so as to incline at an angle of 18 degrees towards the ship, which could be shipped into the centre part of his screw, for trial instead of the ordinary blades. This was acceded to, and these blades were first tried (July 24) with a pitch of 19 ft., the diameter, same as the common screw, 13·2, which gave a speed of 11¼ full, with only 71 revolutions. It was then perceived that by inclining the blades of the screw, it had considerably more hold on the water, and consequently reduced the slip. The pitch was afterwards reduced to 15 ft. (July 30), when a speed of nearly 12 knots was obtained, and with half power (60 revolutions) about 10 knots, the screw making a negative slip of about ⅘ of a knot.

It was then ordered by the Lords of the Admiralty that a temporary bow should be put to her of about 30 ft. long; and a trial was made (September 12) first with the common screw of 13·2 diameter, 20 ft. pitch, and a speed of full 12½ knots was obtained; and with half power (40 revolutions), 10 knots (the temporary bow giving the ship a knot more speed at full power, but no increase of speed at half power), on September 30. She was then tried with Griffith's screw of 13·2 in. diameter, and 19 ft. pitch, when a speed of nearly 13 knots was obtained. In consequence of an experiment that was tried on the *Bullfinch*, by reducing of Griffith's enclosed blades from 6 ft. to 5 ft. 4 in. diameter, and setting it at the same pitch as the common screw of 6 ft. diameter, which gave the vessel nearly half a knot more speed with the same amount of power, it was decided to try the same experiment on the *Flyingfish*. Her screw, with the enclosed blades, was reduced from 13·2 to 12 ft. and 20 ft. pitch (October 18), which gave her a speed of 12 knots, the engine only making 70 revolutions. The pitch was then reduced to 17 ft. (in Oct. 22); engines then made only 75 revolutions, ship 12¼ barely.

She will be tried with the screw, with the enclosed blades reduced to 11 ft. diameter, and 20 ft. pitch; then reduce the pitch, so as to allow the engines to make 80 revolutions.

GREGORY'S PATENT FISH JOINT,

AS PROPOSED TO BE APPLIED TO THE PORTUGUESE RAILROAD, SOUTH OF TAGUS.

This improvement consists in making the fish in one piece, and sufficiently deep to allow a wedge or bearing-piece to be inserted between the underside of the rail and bottom of the fish, which wedge-piece increases the bearing surface, and prevents fouling of the joints. This fish makes a much stronger joint, and only requires two bolts.

Our description will be made clear by a reference to the diagrams, Figs. 1 and 2:—

Fig. 1

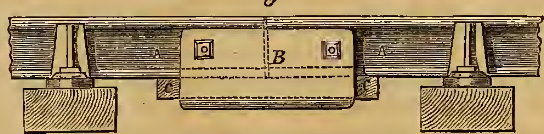


Fig. 2.

Fig. 1 is a side elevation; A A, the rails; B B, improved fish; C, wedge-piece.

Fig. 2 is a view through the centre of bolt, showing the fish and wedge-piece in section. The same letters refer to like parts in each diagram.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(FROM OUR OWN CORRESPONDENT.)

Southampton, October 23rd, 1856.

The U. S. steam frigate, *Merrimac*, which has been moored in the Southampton water off Hamble for some weeks past, will shortly take her departure for a cruise in the Bay of Biscay, and thence to the West Indies.

She has attracted considerable notice during her stay, and visitors were kindly and politely received by her officers, who appeared very proud of their ship, and anxious to show all points of interest to our countrymen.

She is one of six similar frigates lately built by the U. S. Government, and which, from their heavy armament, would prove very formidable opponents in case of action.

	Ft.
Length over all	300
Do. on load water line (24 ft.)	260
Do. on keel	250
Extreme breadth over wales	51·4
Displacement at 24 ft.	4,500 tons.

Built at Boston by Mr. Delano, from designs by the U. S. surveyor, Mr Lenthall.

Frames of live oak, braced with iron bars inside, running diagonally to each other opposite in direction, and continued to the stern and stem. Oak planking, coppered to a little above load water-line, very massive oak knees, between her deck beams, which take up a good deal more room than iron knees, but are cheaper in the States.

Armament.—She is pierced for 60 guns, but carries 40 only, viz., 24 9-in. on her gun deck, each weighing about 4½ tons; 14 8-in. on her upper deck, which also has two 10-in. pivot guns, for bow and stern chasers. The form of the 9-in. guns is different to that usual with us, having considerably *more* metal at and near the breech, and tapering at the muzzle to less thickness than we give to similar sized guns.

The object, of course, is that the strength of the gun at various parts of its bore shall be in proportion to the strain caused by the expansive force of the gunpowder, and this was determined by experiments conducted by Commander Dahlgren, who had holes drilled at regular intervals penetrating from the outside to the bore of a gun, and which holes were loaded with bullets. On the gun being fired in the usual way, the bullets were of course ejected from their holes, and struck a pendulum, thus registering the force with which they were ejected. The varying results thus obtained were afterwards compared with other experiments, and formed the basis for the rule which is now used by the Ordnance Department of the States.

The machinery is by Mr. Parrett, of Cold Springs Foundry, New York; but with the exception of the boilers, does not offer much novelty to an English engineer. The engines are direct acting and horizontal, with two rods to each piston, passing, one above and the other below the crank shaft, to the guides and crosshead, from which the connecting rod returns their motion to the cranks. They are indeed almost a copy of the *Amphion's* engines, and like her's, have their cylinders at opposite sides of the vessel.

During their voyage here, the whole of the brass seats of the air-pump foot valves gave way, being crushed downwards. The chief engineer has had new seats constructed at Messrs. Summers and Day's works here, very much stronger than the old ones, and having considerably more area through them for the passage of the water. The former seats had a number of small, round gratings and valves of india-rubber; the new ones have all their area in one square aperture, by which the elear opening has been increased from 176 sq. in. to 230 sq. in. for each foot valve.

The engines are very much crowded together, and are almost entirely covered with an iron deck, forming a floor-plate for the starting gear above. The slide valves are worked by a link motion, like Stephenson's later slot links; and there is also a separate cut-off, or expansion valve, worked by a separate eccentric, the varying expansion being obtained by a slot in the lever, or weigh shaft, which works the cut-off valve, and by which the stroke of the slide may be lengthened or shortened at pleasure.

This is, of course, a very imperfect mode of working an expansion valve, and we do not think that a separate valve is necessary, where a proper link motion is fitted to the slide valves.

	In.
Diameter of cylinders	72
Stroke of piston	36
Average revolutions at sea	45
Nominal H.P. at 45 revolutions	466½

AIR-PUMPS, HORIZONTAL AND DOUBLE ACTING.

Diameter of air-pumps	22
Stroke „	36

Screw propeller, two blades, disconnecting from the shaft by a T headed coupling outside stern-post, and hoisted in a brass frame through a well in stern of vessel. About 300 men are required for this purpose, their power being multiplied by a double-shieved purchase in hoisting frame. The propeller is of brass, on Griffith's principle, with a varying pitch; but the one at which it is now set is found to answer the proper speed for engines, so that they do not alter the pitch under any circumstances.

	Ft.	In.
Its diameter is	17	4
Pitch	26	2

The boilers are on Mr. Martin's patent principle; that is, the tubes are vertical, and *above* the furnaces, the water circulating *inside* them instead of *outside*, as in the ordinary boiler. A similar boiler was made some years ago in England by Lord Dundonald, for the *Janus*, but he placed the tubes behind the furnaces, as also have the makers of the boilers of the Collins line of steamers, so that Mr. Martin's patent consists, we apprehend, in placing the vertical tubes above the furnaces. There is, of course, a large space between the crowns of the furnaces and the bottom tube plates, for the purposes of tubing and repairs; the top tnbe plates, of course, are sufficiently accessible from the steam space in boiler.

We believe that a difficulty has been experienced in the *Merrimac*, from a deficient draft in the boilers, although the funnel is large in diameter and very lofty; but we think that it may be accounted for from the difficulty of properly sweeping the outsides of the tubes, and which will also operate detrimentally on the efficiency of their powers for transmitting the heat from the fire to the water contained inside them. We understand that when new, and of eourse perfectly clean, an experiment on their evaporative power gave a high result for the lbs. of water per lb. of coal consumed; but we should very much doubt that so good a result would be obtained after a few days' steaming. There are 4 boilers, each having 4 furnaces, the bars of which were at first 7 ft. 6 in. long, but are now reduced to about 6 ft. The furnaces are wide: three of the boilers have each 1,485 brass tubes, 2 ft. outside diameter, and 3 ft. 4 in. long; the fourth boiler has only 1,325 tubes, as 160 have been taken out for an experiment, to give more area for the heated air; should it be successful, the other boilers will be served the same. The boilers are fired athwartships, and appear to be substantially put together, all the seams being double riveted, and caulked inside and out. Shell and furnaces, ⅜ plate; bottom, $\frac{7}{16}$ plate.

The funnel is telescopic, and when in steaming position is 65 ft. high, from fire bars, and 8 ft. diameter.

The ordinary pressure of steam in boilers is from 10 to 12 lbs., and the consumption of American anthracite coal at full speed is about 40 tons per day. She stores 600 tons in her bunkers.

We may mention that her screw-shape bearings are fitted with lignum-vitæ slips, on Messrs. Penn's principle, and, we understand, give great satisfaction, from their little wear.

We are informed that the United States frigate *Minnesota*, a sister vessel to the *Merrimac*, is fitted with engines almost identical with those made by Messrs. Penn for the *Himalaya* and many other steamers, and that they are considered, in the States, to be the most successful of those yet tried.

The speed of the *Merrimac* with steam only, and in smooth water, is about 8 knots per hour; but under canvas and steam together, we believe 12 and 13 knots have been got out of her.

The European and Australian Company's Screw steam-ship *Oneida*, sailed from hence for Sydney on the 19th inst. at noon. Being the first vessel of a new company, she has been the occasion for a good deal of complimentary festivities between the Mayor of our town and the directors and officers of the Company.

Our readers will find a full description of her machinery has already appeared in The Artizan.

Her engines are inverted and direct, acting with three cylinders and two air-pumps, which are worked by rocking levers from the forward and after engines. The slide valves are double ported, and their weight is counterbalanced by an ingenious contrivance. The valve spindle is continued beyond the slide, and forms a piston-rod for the piston of a 10 in. cylinder, which is bolted on to the cover of the slide jacket. The lower side of this cylinder is open to the steam in slide jackets, and the upper side is connected to condenser with a 1¼ pipe, so that the difference of pressure between the steam in jacket and the vapour in condenser, multiplied by the area of the piston, equals its counterbalancing power.

On leaving the docks her draft of water was 20·9 forward and 20·6 aft, with 1,270 tons of coal and fuel on board. The speed of the engines was 31 revolutions per minute; pressure of steam, 20 lbs.; vacuum in condensers, 23 ins.

The *Oneida* was not tried at the measured mile, in Stoke's Bay, as the other vessels which carry mails are, because the contract does not require that test; the substitute being a penalty for an excess of time beyond that contracted for the conveyance of the mails.

This company have chartered the Peninsular and Oriental steam-ship *Simla* for the conveyance of the Australian mail of the 12th November; she will be followed on the 12th December and January by the *Columbian* and *European;* and on the 1st of February the regular service will commence, *viâ* Alexandria, Suez, Pont de Galle, Melbourne, and Sidney.

The three new screw steam vessels now building for this service in Glasgow are expected to attain a very high rate of speed. We understand that their engines are all on the inverted direct action principle, with very large boiler surface.

ON THE DYNAMOMETRICAL INDICATOR FOR STEAM ENGINES,

AND A SIMILAR INSTRUMENT

Designed by D. VAN DEN BOSCH, Engineer, Marine Steam Department at Hellevoetsluis.

WHEN the eminent *James Watt* improved the engine of *Newcomen* as it was left by *Smeaton*, by substituting the pressure of steam for that of the atmosphere, he endowed it with quite a new and peculiar power. This important improvement led him naturally to the research of the value of that pressure, and of its effect on the steam piston during the alternate changes, as the weight of the atmosphere was no longer available as a means of indicating its power.

The fertile genius of *Watt* speedily devised a proper expedient for the inquiry. As his useful application of a syphon filled with mercury would not indicate the pressure of the steam entering or escaping from the cylinder, he made a direct communication between the cylinder of the steam engine and a small cylinder, with a piston accurately fitted to it, so as to move easily up and down; and attached to this small piston a spiral spring, the tension of which was read off on an annexed scale, agreeing with the steam pressure within the large cylinder. The piston rod was provided with a pencil, which described, by rising or falling, the measure of the steam pressure, and at once, for all the positions of the moving piston of the steam cylinder, as the paper in contact with the pencil followed the same motion.

The figures or diagrams obtained by this simple instrument, give not only a clear idea of the different pressures on the steam piston, but they show whether the steam enters or escapes at the proper time; whether the steam passages are large enough, or whether the slides or piston are leaky. The indicator of *Watt*, embracing so many useful indications, exhibits the same beautiful simplicity which shines through all his contrivances, and excels in this respect all the alterations applied afterwards, which consist of more closely joined parts, and of being more fit for application to marine engines, though they are by no means more accurate.

As the indicator gives figuratively an explanation of the alternate state of the steam pressure within the cylinder, it is easy to conceive that such a diagram contains the means to ascertain the power of an engine. *Watt* showed this clearly in his researches, with his rapid and clear conception, but not on such principles as were prescribed afterwards, when, by the increasing use of steam engines, greater interest was felt to know exactly its useful effect.

The manner in which this is ascertained at present is, to my opinion, not sufficiently accurate, while that rule depends in principle upon an improper measurement of the diagram, and gives results which are 1-7th to 1-10th too great, which difference exceeds the limits of accuracy that may be obtained by an indicator.

In all indicator diagrams properly executed, the succeeding pressure of the steam on the piston is distinctly given; but a diagram described on paper, having the same motion as the piston, is not so fit to take off the proper measures for calculating the powers of an engine—this will be shown hereafter.

By using the instrument that I have made for the purpose—which will be called hereafter "the manograph"—no connexion is necessary with any moving part of the engine to give the requisite motion.

All we wish to know for calculating the power of an engine by means of a diagram, consists of the average pressure of the steam. Such a pressure is necessarily supposed to act uniformly, *i. e.* constant during the same length of time. Now, in every steam engine where the reciprocating motion of the piston is transmitted to a crank-shaft, we may only consider the latter as to move with a uniform velocity; the paper, therefore, on which we desire to take a diagram, should be put in motion by the crank-shaft—as is done very often for locomotives—to give the succeeding steam pressures during equal length of time. This agreed, it will be clear, that any other uniform motion, whether of any velocity, is equally sufficient to move the paper, if we are only able to discern in the described figure what agrees with the *in* and *out*-door stroke. This will be directly perceived, as the great difference of pressure of the entering and escaped steam are distinctly indicated.

The manograph, like the indicator, is provided with a cylindrical barrel, on which the paper is wrapped, but which revolves only in one direction, without being connected with any moving part of the engine. The motion is given within the barrel by means of a wound spring, which unwinds itself uniformly. It is, therefore, not reciprocating, like that of an indicator, but will produce a figure like Fig. 2, while that of the indicator will be like Fig. 1.

In both figures is A, A, the atmospheric line, and B, C, D, E, F, the curve of the succeeding pressures on the piston. According to the common rule, which is still in general use, the average pressure is found, by dividing the atmospheric line by a series of equi-distant vertical lines, and measuring the length of the vertical distances of the curve in the middle of each vertical space; add these together, and divide the sum by the number of vertical spaces. In the diagram, Fig. 2, of the manograph, the average pressure is obtained by adding together for each half of the atmospheric line, the distance of the curve in the middle of each space to a line, G, G, drawn parallel to the atmospheric line, and dividing the difference of the two results by the number of vertical spaces of half the atmospheric line.

The manograph diagram, Fig. 2, is deduced from the indicator diagram, Fig. 1, to represent the curve, which would have been described by the manograph instead of the indicator; so that when each figure is calculated according to its proper rule, that of the indicator will give for result an average pressure 1-8th greater than that of the manograph, though the latter will be the nearest to the truth.

To obtain from an indicator diagram the same corrected result as that of a manograph, half a circle should be described, of a diameter equal to the atmospheric line, A, A, Fig. 3. Divide half this circle into equal parts, and draw from these points vertical lines to a line, G, G, parallel to A, A; next, measure, in the middle of the vertical spaces, the distances from the upper curve, B, C, D, to G, G; from the sum of these distances deduct the sum of the distances from the lower curve, D, E, F, to G, G, and divide the rest by the number of vertical spaces; the quotient is the average pressure. When the same diagram is measured in the usual way the average pressure will be 1-10th more.

The last figure is an enlarged copy of a diagram (Plate ii. of Mr. Bourne's "Treatise on the Screw Propeller"), taken from the engine of Her Majesty's steam-ship *Alecto*, and where the average effective pressure is noted 13·24 lbs. per sq. in. Fig. 1 is a copy of a diagram (No. xli.) in *Mr. McNaught's* description of his improved indicator, taken from the engines of a screw-ship, and where the average pressure, without any deduction for friction, is 17·12 lbs. per sq. in. Fig. 2 is, as before mentioned, deduced from Fig. 1, to explain the rule according to which the manograph diagram should be calculated.

To ascertain accurately the power of an engine, diagrams of both sides of the piston should be taken; but often a single diagram is used to make an approximate calculation. In reference to that the indicator and manograph makes no difference; but if with a single diagram we wish to have a clearer idea of the varying state of the steam pressure on the piston, half the curve of the indicator diagram should be reversed, as is shown by a dotted line in Fig 1; but in that of a manograph, one half of the curve should be shifted in the same direction against the other half of Fig. 2. In such an altered diagram, will be observed more clearly the counter pressure which resists the moving piston at the end of the stroke, on account of the exhaust passage being opened by the lap of the valve before the end of the stroke, and by the steam entering on the other side of the piston when the valve is to have lead. This counter pressure is more distinctly shown by the manograph, besides the various indications that are given at the return stroke.

The construction of the manograph will be explained by Figs. 4, 5 :—A, a small cylinder truly bored, in which a piston, accurately fitted, moves easily; B, a tube screwed on the top of the cylinder, containing a guide for the small piston rod, and a spiral spring, which may be taken

DYNAMOMETRICAL INDICATOR FOR STEAM ENGINES.

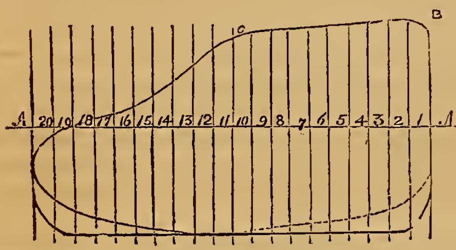


Fig. 1.

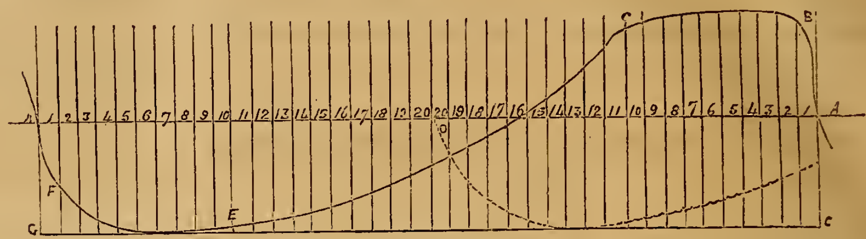


Fig. 2.

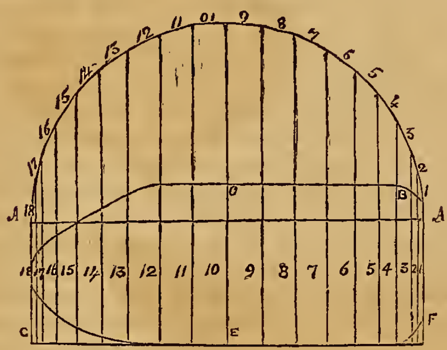


Fig. 3.

out, together with the piston, by unscrewing the notched top ring, convenient for cleaning these parts after having used the instrument; C, a stop-cock fixed to the cylinder bottom, provided with a nut, by which the manograph is attached to the large cylinder; a small hole is drilled through the plug to admit the air for taking the atmospheric line, when the steam is cut off by the stop-cock; D, pencil-holder, which moves with the piston through a small channel in tube B; this holder, which consists only of an easily-bending spring, can readily be put in or taken out when the parts are to be cleaned, or to preserve the neatly-pointed pencil from injury; E, graduated scale, on which the steam pressure is shown in pounds per sq. in., from the vacuum point to 20 lbs. above the atmosphere; F, is a rest for the pencil-holder, by which it may be withdrawn, or brought gently in contact with the paper, by a slight movement, for which purpose a string may be attached to one of the small knobs, *a*; G, paper-barrel, which is placed with a centre pin in the arm, *b*, and can be taken out for wrapping it with paper by simply pressing against the spring-latch, *c*; within this barrel is enclosed a spring with a winding-off movement, and which may be wound up by turning the barrel by hand; it is kept in this state by a ratchet-wheel, *e*, fixed to the bottom of the barrel; H, crank of the ratchet, which, being drawn out, allows the paper-barrel to revolve, for drawing out this ratchet may serve the other end of the above-mentioned string; I, top of the paper-barrel, which may be unscrewed, for regulating the velocity of the revolving barrel when necessary.

I presume this description is sufficient for every one who is acquainted with the common Indicator. The measurement and calculation of a manograph diagram offers no difficulties; we should only be careful that the divisions on the atmospheric line are taken between the two similar cuttings when the steam begins to enter the cylinder. The atmospheric line will serve also for describing the vertical lines in diagrams of non-condensing engines, while the divisions on the atmospheric line will remain

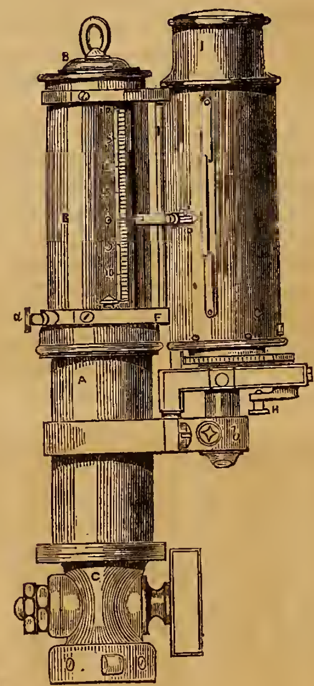


Fig. 4.—Elevation

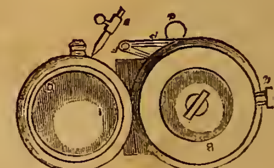


Fig. 5.—Plan.

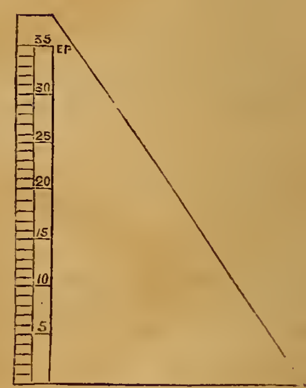


Fig. 6.

between two similar points, which are always clearly indicated at the returning stroke when the steam begins to enter the cylinder. To measure for non-condensing engines, the ordinates from the atmospheric line, and for condensing engines from a line, G, G, parallel to it, will be done readier and more accurately, by using a small three-square of box-wood, Fig. 6. On the feathered edge of one of its sides, the same scale is engraved as on the manograph; placing a rule on the parallel line, G, G, of the diagram, and shifting the three-square along, the measures are easily read off.

The advantages which a manograph (Fig. 4) offers are as follow :—More accurate results for the average steam pressure; having no connection with any moving part of the engine, it may be applied as easily to oscillating as to fixed cylinders; a convenient management of the pencil, with an arbitrary control of the paper-barrel, so that various neat diagrams may be taken on the same paper without it being necessary to touch the manograph by hand, as the barrel may be wound up by a string passed round the top; a clearer indication of the steam pressure at the beginning and at the end of the stroke; readier means to take the instrument to pieces for cleaning, which should always be kept in a good state; to which may be added, it does not exceed in price any other good indicator at present in use, as the manograph does not need any appendages at all to give to the paper-barrel the requisite motion.

It will be granted to me to conclude these lines with a remark—namely, that it would be desirable to allow for loaded engines a fixed unit for friction, when calculating the average effective pressure by a diagram, and put aside all other proposals. By following the same rule we shall promote the better understanding of the said power. That which has been mentioned by Mr. Atherton, chief engineer at Woolwich dockyard, in a lecture read before the Society of Arts, the 16th of May, 1855, seems to be convenient—namely, to multiply the area of the piston by the gross average pressure of the diagram and the velocity of the piston in feet per minute; divide this quantity by 44,000, the quotient is the effective horse-power of the engine.

D. VAN DEN BOSCH, L. K. INST. I.

Hellevoetsluis.

FRANCIS'S CORRUGATED METALLIC BOATS, MILITARY BAGGAGE WAGGONS, &c.

WE are happy to have the opportunity of calling attention to another instance of the advantages derived from really good and practical inventions being brought before the public by means of the British Association meetings.

Major Vincent Eyre, F.R.G.S., read a paper upon this subject in section G., at the Cheltenham Meeting of the British Association; and public attention in this country being called to the subject, whereby the Government, through the War Department, directed a trial of the

Fig. 1.

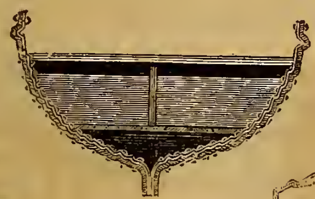
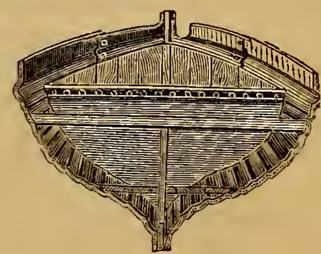


Fig. 2.

Fig. 3.

Fig. 4.



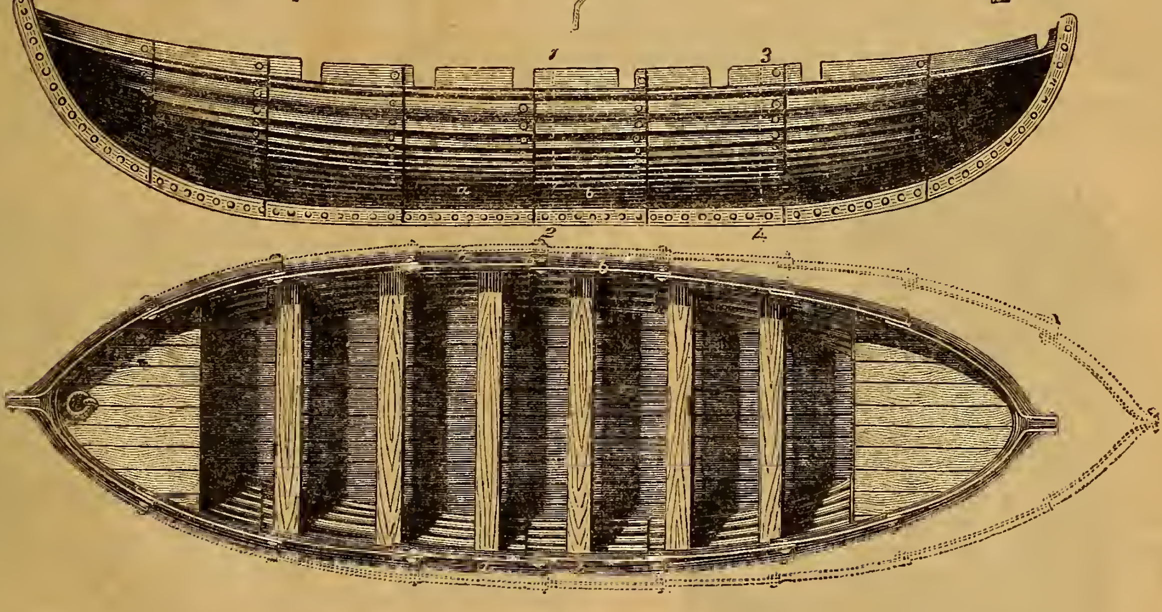


Fig. 9.

military baggage-waggons, constructed by Mr. Francis, to be immediately made, and the Woolwich authorities proceeded, without loss of time, to put them to every variety of test to which it was possible to subject them; the result has been highly satisfactory, and they are now ordered to be adopted.

The corrugated metallic life-boats have also, since the reading of this paper at Cheltenham, received a considerable share of public attention; and, after repeated trials, are approved by the Life Boat Association, and other important authorities.

The life-saving cars are also highly approved of, and a description of them, extracted from the "Life Boat Journal," is hereafter given.

With respect to corrugated metal boats for various purposes, the following will give a general idea of them, and also of the mode of manufacture:—

The material of which these boats have chiefly been constructed is galvanised iron, although some have been made of copper. Of the latter description were the boats used by Lieutenant Lynch, of the United States' Navy, in the exploration of the Dead Sea, in 1848, when they were reported on by that officer in the highest terms, as having repeatedly descended rapids and cataracts amidst rocks and other experiments without injury, whilst the only wooden boat that accompanied him was almost at the outstart knocked to pieces and sunk. In a letter to Mr. Francis, in March, 1849, Lieutenant Lynch says:—"With no other kind of boat, however strongly constructed, could the descent of the Jordan have been accomplished, and the expedition must have been unsuccessful without them."

Galvanised iron has, however, been selected as the material for ordinary ships boats, it being much cheaper than copper, and the experience of several years having shown that the galvanising process, when properly performed, will effectually protect the iron from destruction by oxidation.

The chief feature of Mr. Francis's invention is the adoption of huge cast-iron dies, corresponding in form to that of the boats to be constructed, as shown in the accompanying illustration. The lower and concave die, forming the matrix, has its surface grooved in longitudinal channels, corresponding in depth and form with the intended corrugations of the metal, whilst the surface of the pper and convex die corresponds with it inversely. The two dies are fixed nd nicely adjusted in a powerful hydraulic press, as shown in the illustration efore referred to.

The galvanised iron plates, of which the boats' sides are to be formed (weighing from $1\frac{1}{2}$ to $2\frac{1}{4}$ lbs. per superficial foot, according to the character of the boat), are placed between the dies, which are then slowly brought together, and submitted by the hydraulic power to an enormous pressure, equal, it is said, to 800 tons. The whole side of the boat, or as large a portion of it as the largest-sized sheet of iron will allow of, is thus stamped into its proper form, and corrugated by one simple operation. The permanency of this form and also great strength are secured by the corrugations in the iron, which are likewise so skilfully varied in depth and form as to secure the greatest strength where most required, and to prevent the wrinkling or puckering of the metal in the operation of changing the plane surface of the original sheet to the varying curves of the different parts of a boat.

The two sides of a boat being thus quickly formed, each in one or more parts, according to the size of the boat, they have only to be riveted together, and to the keel, stem, and stern posts, when the boat is formed complete, with the exception of the thwarts and other interior fittings, which are subsequently added. A vast amount of labour and consequent expense is thus economised, whilst the corrugation of the iron imparts so great a degree of strength and rigidity to the whole structure, that, except for the convenience of rowing, the thwarts might altogether be dispensed with.

As a metallic boat, if swamped, would of course immediately sink, air-chambers are placed within the boat of sufficient size to make her insubmergible in the event of being upset. To that extent, therefore, all these metallic boats are life-boats.

The presumed advantages of Francis's metallic boats may be thus summed up.

1. That they can be made cheaper than boats of wood.
2. That they are not only perfectly watertight when built, but that they will remain so under all changes of temperature and climate, or exposure to the heat of the sun.
3. That they are much stronger than wooden boats, and not liable to be stove in, or fractured, by striking on rocks or other hard substances.
4. That they are more durable than boats of wood, and under ordinary circumstances never need repair.
5. That they are fire-proof.

These alleged advantages are so important, that if they should be confirmed by experience in this country, the metallic boats cannot but, to a great extent, supersede the use of boats of wood; whilst their inventor must be looked on as one of the benefactors of mankind. For how many lives have been lost, from time to time in boats, from the want of such qualities as those in question are said to possess.

The press for puckering up the metal plates and carving them correctly is shown in the accompanying illustration, Fig. 7.

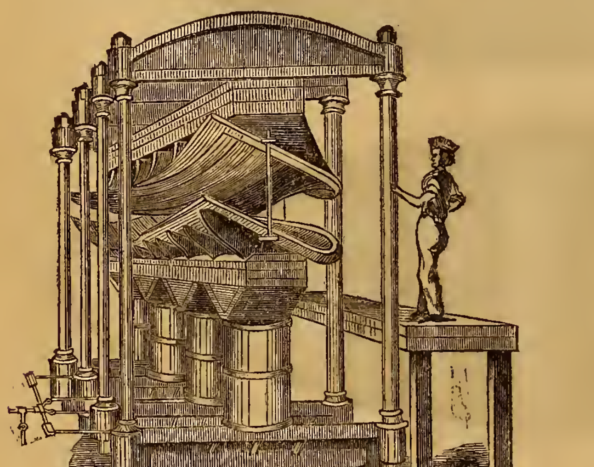


Fig. 7.

The accompanying illustrations, Figs. 1 to 6, show several views of a corrugated iron boat and detached details thereof, which require no further explanation.

With reference to Mr. Francis's Metallic Life-saving Car, the following description will make its construction and use perfectly understood :—

The great advantages of the car are, that it will take in four or five persons at one time, and not only convey them safely to the shore, but will so effectually preserve them from the effects of the sea that they will not even get wet on the passage through the heaviest breakers, whereas, by the ordinary conveyances hitherto in use in this country, one person only at a time can be conveyed to the shore, and that not without serious liability to injury, on some occasions, from the violence of the sea, or even to be drowned by being hauled through it.

The life-car is made in the form of a whale-boat, of galvanised iron-plate corrugated, the top being arched over or roofed, like *the* ark of old; of which, indeed, on a small scale, it is a fitting emblem; for are not the dangers of shipwreck as great and as fearful to those who are exposed to it as was that great wreck of all things on the then habitable globe, to the contemporaries of our forefather Noah? And must not the deliverance to the inmates of this little ark of mercy be as complete and as grateful to them as was that afforded to the ancient patriarch and his family in that huge structure which afforded them a safe refuge from the waters of the great flood, when all the peopled world beside succumbed to that vast calamity?

The life-saving car, or *ark*, as we think Mr. Francis might more befittingly designate it, has a single opening in the roof, which provides for the ingress and egress of those taking refuge in it, the same being furnished with a lid or hatch, which prevents the admission of water whilst battling with the surf on its passage shoreward. The only provision for the admission of fresh air is through small holes not larger than those on the rose of a common garden watering-pot. No inconvenience has, however, been experienced on this account, on any of the occasions when it has been used with such success in the United States; and on a recent trial of it, at the Great Yarmouth Regatta, as many as ten boys were shut up in it, whilst they were hauled to and from a boat at about 120 yards from the beach, the time occupying between three and four minntes; no distress being felt by them from an insufficient supply of air.

This car is 10 ft. 9 in. in length, and 3 ft. 9 in. in width. A part of the interior space, at the extremities, is occupied by air chambers, as shown in the annexed diagrams, which, however, do not correctly show the shape of the upper body of the car, which in those now manufactured is a perfect arch, both laterally and longitudinally, a form which affords greater strength, and a larger supply of air for the consumption of those shut up within.

Figs. 8 and 9 are views of the Life-saving Car.

Fig. 8.

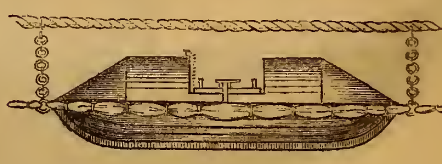


Fig. 9.

Having detailed some of the various modifications of Mr. Francis's application of metal, we are glad to be able to state, upon evidence furnished to us, that the following progress has been made in introducing this invention, which we think is highly satisfactory.

Orders from U.S. Treasury Department for Francis's Metallic Life Cars.

June 26, 1856, ten cars for New Jersey. August 23, 1856, eighteen cars for coast of Long Island. August 28, 1856, two cars for coast of New Jersey.

Orders from U.S. War Department.

January 26, 1856—fifty metallic pontoon army waggons; February 8, 1856, eight six-oared metallic barges; February 8, 1856, twenty metallic batteaux, for the everglades in Florida, for the use of the army; October 1, 1850, fifty metallic boats for the use of the troops in Florida.

Extract from a letter by Capt. Edwin Smith, of the brig *Susan*, of Sag Harbour, Long Island, in reference to a metallic whale boat:—"I used her for whaling; also to get seal, elephant, and penguin oil. I could land with her through the surf in the ice, and on rocky coast, when wood boats could not have been used. During a voyage of two years, notwithstanding the hard service, I did not have occasion to make the slightest repairs, and on my return the boat was as good as new, and has now gone on a second voyage in the brig *Parana*. I wish you to build me two for this vessel. I take no other boats for use, being confident that *two metallic boats are equal to six wooden ones.*"

Order from E. K. Collins (Collins' Line Steamers).

September 15, 1856—one extra large boat for the new steamer *Adriatic*. All the boats of this steamer, and of the Line, are Francis's Metallic Life Boats.

New York and Liverpool U.S. Mail Steamers,
56, Hall Street, New York, Nov. 2, 1854.

Sir,—You will build immediately five metallic life boats extra for *each* of our ships, believing that they are the only boats that can be at all times relied upon for *immediate use*, which, with the boats of yours they now have, and the improvements you will make, we hope to be able to provide for 400 persons (each ship) with water and provisions.

Yours respectfully,
(Signed) Edward K. Collins, Agent.

To Joseph Francis, Esq., New York.

The Glasgow and New York line of steamers are furnished; in particular the steamer *New York*, of the line, which has a full suit of extra row-boats.

Cunard steamers are furnished. The splendid steamer, *Persia*, of the line, has just been furnished with four of extra size.

Also the Liverpool and African line.

The above boats, and many others, were ordered by *English ship* OWNERS, from the United States. The cost is much more than if made in England, as the principal material in the construction (galvanised iron) is made *here*, and sent to the United States, subjected to the cost of *duties, transportation, commissions, exchange, &c., &c.*; yet, for all, these English shipowners order the boats, as they can nowhere else be obtained.

Messrs. T. B. Coddington and Co., 21, Water-street, Liverpool, have just received, by the *Persia*, from New York, a Francis's Metallic *Section* Boat, ordered for Capt. Burton, the celebrated traveller, who is about to proceed on an exploring expedition to Central Africa, under the auspices of the Royal Geographical Society. The boat is *looped up in sections*, and to be transported in that state to the great lake, some 500 miles west of Zanzobar. The boat has been sent (this week) to Portsmouth dockyard, where the ship lays.

Capt. Stewart Van Vliet, United States army, in his official report to the War Department, December 14, 1855, says:—"When I left Fort Leavenworth I procured of General Harvey six metallic waggons, and, for the purpose of testing them, loaded them in the ordinary manner with 2,000 to 2,500 lbs., and subjected them to the same treatment as the other waggons. I had no opportunity of trying them until I reached the "big Sioux," the boundary line between Minnesota and Iowa. At this point the river was wide and deep. I crossed the river without trouble. I found the bodies to be a most excellent *boat*—very buoyant, and capable of supporting a great weight. The waggons which I experimented with had been subjected to the rough treatment of a MARCH OVER 1,200 MILES, through broken and uneven ground, and the result, after such usage, I consider very satisfactory. The result of my experiment with the metallic waggons is briefly this—that I consider them of great importance to an army in the field, where rivers are deep. Lashing the bodies together, two and two, a good and substantial bridge can be made, over which troops, in an unbroken line, can march with ease and safety."

Boats for the Navy have been ordered by the Admiralty, and experimented with and approved. The adoption must create an enormous saving to Government.

After repeated and thorough experiments and examinations by scientific officers, Lord Panmure has officially informed Mr. Francis that he has decided to purchase a privilege to manufacture metallic army waggons, at the price offered.

A factory will be at once established at the Arsenal, and the saving in cost of waggons to Government will be enormous.

AMERICAN NOTES, 1856.—No. XI.

STEAM NAVIGATION.

DIMENSIONS OF STEAMER "SANTA CRUZ."

Hull by Thomas Colyer; Engines designed and superintended by Joseph Belknup, of New York.

Length on deck	130 ft.
Breadth of beam	26 ft. 6 tnths.
Depth of hold at ditto	11 ft.
Depth of hold to spar deck	11 ft.
Length of engine space	36 ft.
Hull	200 tons.

Kind of engines, vertical direct; ditto boilers, return fluid; diameter of cylinders, 2 ft. 2 in.; length of stroke, 2 ft. 2 in.; diameter of screw, 9 ft.; length of screw, 2 ft.; pitch of screw, 18 ft.; number of blades, 4; number of boilers, 1; length of ditto, 21 ft.; breadth of ditto, 9 ft.; height of ditto, exclusive of steam chests, 9 ft. 10 in.; number of furnaces, 2; breadth of ditto, 9; height of ditto, exclusive of steam chests, 9 ft. 10 in.; number of furnaces, 2; breadth of ditto, 3 ft. 10½ in.; length of fire bars, 7 ft.; number of flues, 4; internal diameter of ditto—two 18½ in., two 11½ in.; length of ditto, 14 ft. 7 in.; diameter of chimney, 44 in.; height of ditto, 24 ft.; area of immersed section at load draft, 180 ft.; heating surface, 1,280 ft.; draft forward, 9 ft.; ditto aft, 9 ft.; ditto boilers, without water, 30,000 lbs.; frames, 10 in. × 8 and 10 in., and 24 in. apart; depth of keel, 9 in.; independent steam, fire, and bilge pumps, 1; masts, 3; rig, 3-masted, fore-top and schooner; intended service, San Francisco to Monteres.

SIBBALD'S BOILER.

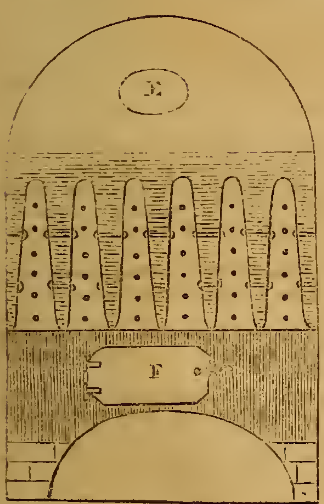


Fig. 1.

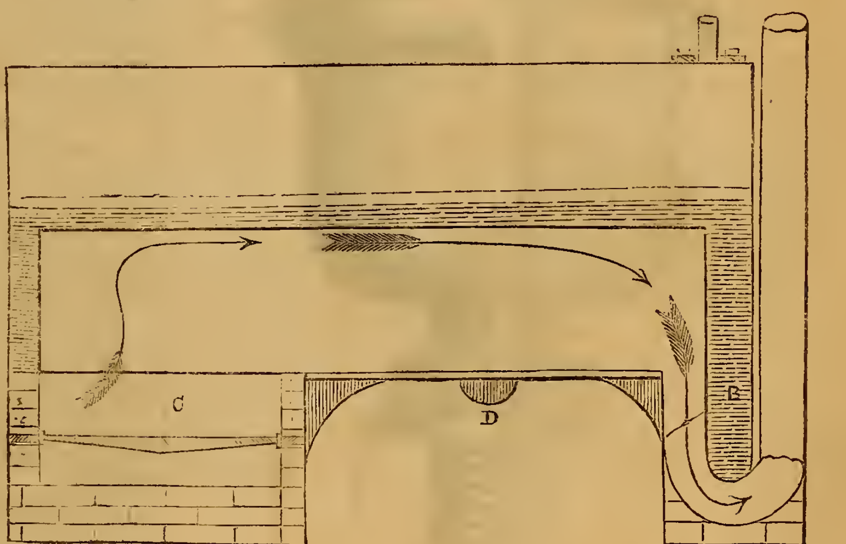


Fig. 2.

STEAM-ENGINES, &c.

Novel Boiler.—C. F. Sibbald, of Philadelphia, has lately designed a form of flues for boilers which has been adopted by several parties in Philadelphia, and the results, as certified by them, published in a pamphlet.

Messrs. J. T. Sutton and Co. declare to have effected a saving of *two-thirds* in the consumption of fuel by the use of it.

In another case, a committee appointed to test the merits of this boiler, report to have evaporated 14¾ lbs. of water with it with 1 lb. of coal.

The boiler is 7 ft. 10 in. long, 33 in. wide, and 3 ft. 6 in. in height above the fire-box. It is 10 H.P., and contains 130 ft. of effective heating surface. It was working an engine having an 8 in. cylinder, with 2 ft. stroke, and making 60 revolutions, and was doing all the work of the shop—bending, blowing a fan, boring, &c. During the experiment a north-east storm prevailed, with rain, and the boiler was out of doors, merely covered by a shed. Notwithstanding this, the result proves that 14¾ lbs. of water was evaporated with 1lb. of coal (anthracite). The steam was blowing off at 60 during the entire period, in sufficient quantities, in our opinion, to have worked another engine of equal power doing the same work. The consumption of coal was under 30 lbs. per hour, which we understand has been the average for three weeks past, during which time the said boiler has worked the said engine.

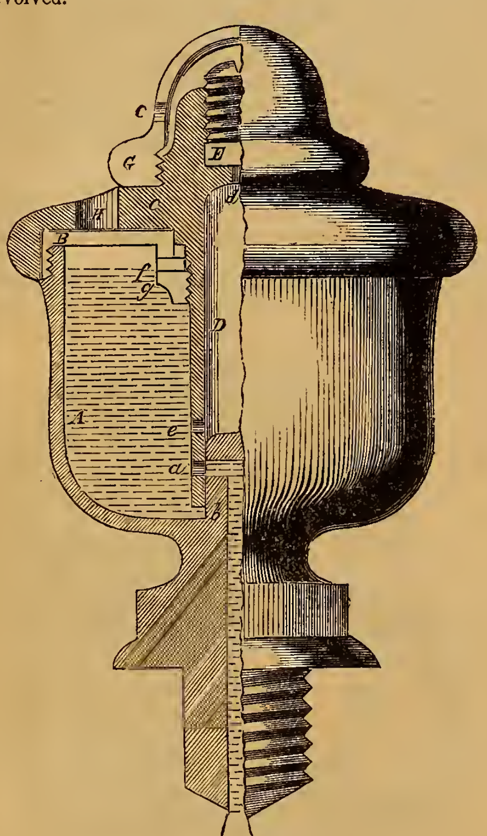
Description of Drawings.—A, front view of flues, which run longitudinally through the boiler. They are from 1½ ft. to 3 ft. deep,—say 2 in. at the narrowest, 4 in. at the widest part, communicating with the cross flues B, at either end. C, the fire-chamber, showing the direction of the heated air and gases, and that one-third of the flue surface is exposed to the radiant heat, directly over the fire-grate. D, a slide that confines the heat, and is so constructed that the soot or ashes may be removed when desired. E, the man-hole. F shows a cast-iron fire-front, set in brickwork, left open to show the fire-chamber at C.

N.B.—The above represents a 20-horse boiler. The flues are 10 ft. long; cross-flues, 4 in. wide each; width of the boiler, 3¼ feet; height above the fire-chamber, 4½ ft.—having 6 flues, and giving 240 ft. of effective heating surface.

MISCELLANEOUS.

Self-feeding Atmospheric Oil Cup.—Mr. John Sutton, of this city, who has had much practice in the designing of oil cups and lubrication, has just completed a novelty in the way of an oil cup which is used without wick.

Construction.—A. is the oil cup; B, the fixed cover; C, the universal cover with air chamber D, which also serves to prevent the oil running away while filling; E, is an elastic body or other arrangement acted upon by the adjusting plug F, by which the air is shut off or let on at will; G, is the dome or guard for preventing anything interfering with the plug when set to suit; H is a hole drilled through both covers for receiving oil; *a* is a passage drilled through the fixed plug *b* and air chamber D, at right angles with the hole in the fixed cover. The air chamber passages being drilled on the line of the plug in the universal cover—so that when the holes in the covers are open, the passage *a* is cut off—and when the superior cover, C, is turned one-quarter its circle, either side from the aperture in the fixed cover, it is an air-tight joint while the passages of the air chamber and plug *b* being on the same line are entirely open; *c* is a passage for air from the atmosphere to the interior of the dome; *d* is a passage for air from the regulating part to the air chamber; *e* is a passage from the air chamber to the oil; *f g* is a washer and nut for holding the two covers in contact and air-tight, yet easily revolved.



SELF-FEEDING ATMOSPHERIC OIL CUP.

Directions for Operation.—Determine the number of drops required per day, for the part; procure a cup holding that quantity; before putting it on the machine place it in a bottle, for convenience, screw down the plug tightly, and fill the cup through the hole in the cover—then turn the cover to its stop or quarter circle, which will also open the passage *a*, within—now tighten or slacken the plug, thus decreasing or increasing the admission of air, which entirely governs the feed of the oil, until it delivers the quantity required per hour, minute, or second. Should a journal require 200 drops per day, shut off the air until it drops 20 per hour, or one drop in three minutes, when it may be applied to the part, it is readily perceived how easily and soon it may be regulated.

Griffith's Shipbuilder's Manual.—Mr. J. W. Griffith, of this city, well known as an eminent shipbuilder, and the editor of the "United States' Nautical Magazine," has published a shipbuilder's manual and nautical referee (large octavo, pp. 400), in which he has not only given a very instructive and interesting essay upon the elements of the requirements of the model of vessels and steamers, but he has entered into an investigation of the conditions of buoyancy, stability, pressures, &c., with a force of reasoning and argument that these subjects have been rarely treated of; added to which he has given memoranda of the dimensions, displacements, and scantlings of many successful vessels, together with copies of their drafts (elevations and sections), their fastenings, &c., which makes his book one of the most valuable works on ship-building ever published. I commend it to your notice.

A Monster Locomotive.—There was a few days since, at the Baltimore and Ohio railroad depôt, an engine which is said to be the largest in the United States. It was built by Mr. Ross Winane, at his shop in Baltimore, and is named *Centipede.* It has 12 wheels 44 in. in diameter, 22 in. stroke, 11 ft. furnace, and weighs 33 tons. This engine has been built as an experimental one, to test the practicability of drawing a train of six passenger-cars up the heavy grades on the road (of which some are 117 ft. to the mile) at the rate of 25 miles per hour. It is said that this monster is capable of accomplishing it with apparent ease. This engine presents a singular appearance from those now in use; one striking feature is, that the engineer stands in front.

New Line of Atlantic Steamers.—The Montreal Ocean Steamship Company have given notice that five first-class powerful screw steamers will form the Government mail line between Montreal and Liverpool. The steamers are named *North America*, *Anglo-Saxon*, *Indian*, *Canadian*, and *Sardinian.* They are to leave each city semi-monthly.

New Line on the Pacific.—There is completing, in this city, a new steamer for the route from San Francisco to Monteroy. She was built by Thomas Collyer, Esq., under the general supervision and direction of Jas. G. Betkness, Esq., and she will be ready for service in all the next month.

Bull's Patent Safety Pump.—This pump is designed for the purpose of affording a regular supply of water to a boiler; and after two years' successful experiment at the works of Ames' Manufacturing Company, it is offered to the public, with the assurance that it accomplishes its object with unerring certainty.

By its use the water in the boiler is kept at an unvarying height. It is operated by the steam from the boiler when filled, regulating its own speed to meet the exact supply of water required, and a glance at it is sufficient to assure the engineer that the water in the boiler is at its proper height. It is simple in its construction and easily managed.

It is for sale by the Ames' Manufacturing Company of Chicopee, Mass.

Burnett's Patent Independent Crane.—The invention relates to certain improvements, which simplify and cheapen the cost of that class of cranes which are constructed and used for hoisting marine steam-engines and boilers, or moving heavy bodies with facility and dispatch.

The improvement consists—first, in transferring all downward pressure of the main-brace to the top of the tower by means of a back-stay, leaving only a lateral horizontal pressure against the side of the tower at the circular way.

A second improvement is an arrangement of anti-friction rollers working in a circular frame, and left free to travel around when the jib is in motion.

The third improvement consists in the formation of a segmental circular traveller, with seats to receive the back-stay timbers, by which the traveller is held in a proper position.

Fourth. The separation of main-brace and back-stays from the jib downwards, sufficient to prevent the possibility of their tipping out at the bottom.

This arrangement permits the easy swinging around of the jib and its load; for this purpose, a stationary winch and gearing is employed, working in a rack on the tower. Two men only are required to move the jib with its weight around.

This crane is simple in its construction, being a combination of a few members which act together, and capable of being strengthened in every part to almost any extent, by mere enlargement of parts. Care has been exercised to use the strength of timber to the best advantage in the way of tension and compression. All vertical pressure is received on the top of the tower, and all the lateral or horizontal stress against its side, while the structure of the crane is such as to meet these strains most perfectly.

This plan for a crane may be adopted in iron foundries, forges, railroad depôts, &c., by making the tower 20 to 30 ft. high, and from 4 to 6 ft. in diameter at the base of boiler iron, from ¼ to ⅜ of an in. thick, secured to masonry at the base, independent of the roof or any other support; or a tower may be formed of plank 5 in. thick, staved up and hooped.

The invention combines strength, safety, and durability, with economy of use and construction. The engraving shows the design for one of these cranes, which is capable of lifting 150 tons, and which is now in course of erection at the Novelty Iron Works. H.

BRITISH ASSOCIATION.*

SECTION G.—Cheltenham, Tuesday, August 12.

ON THE DISTRIBUTION OF THE VERTICAL SHEARING STRESS IN BEAMS.

By W. J. Macquorn Rankine, C.E., F.R.S. London and Edinburgh, Regius Professor of Civil Engineering and Mechanics in the University of Glasgow.

Although it has long been known that at each vertical transverse section of a loaded beam there is, besides the bending stress, a vertical shearing stress whose total amount is equal to the load supported at the vertical section in question, yet it is only of late years, and especially since the introduction of plate and lattice girders, that engineers have found it necessary in practice to take into consideration that shearing stress in determining the dimensions and proportions of beams; and hitherto their calculations have had reference chiefly to its *total amount*, with little or no regard to its *mode of distribution* in different parts of the same vertical section.

The mathematical principles which regulate the distribution of this kind of stress have been the subject of elaborate investigation by various mathematicians, but they have not hitherto been reduced to a form suitable for easy application to practice. The present paper is designed to supply this want. It does not contain any new theoretical principle, neither do its results constitute a theoretically complete and exact solution of the problem of the distribution of stress amongst the particles of a beam; but it gives rules and formulæ by which the vertical shearing stress at any point (being the stress next in point of importance to the bending stress), and the result of the combination of that stress with the bending stress, may be computed with a degree of accuracy sufficient for practical purposes. The following is an abstract of the method pursued.

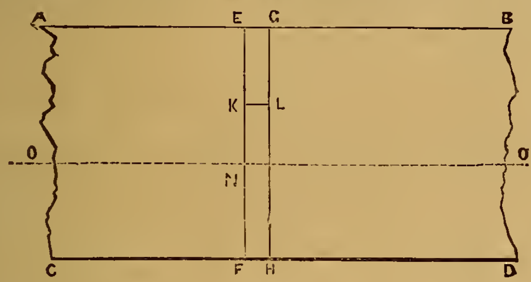


Fig. 1.

The horizontal compressive or tensile stress produced by the bending force at each point in the beam is first to be determined in the usual manner. This having been done, let A, B, D, C (Fig. 1), be a side elevation of a portion of the beam, and let it be required to find the intensity, or amount per square inch, of the vertical shearing stress at a point K. Let E, K, F, be a vertical plane passing through K; G, L, H, another vertical plane very near K, the distance between those planes (which may be denoted by dy) being very small as compared with any dimension of the beam. Let K, L, be a horizontal plane. Compute the total amount of the horizontal stress acting on the portion E, K, of the plane E, F; denote this by h. Compute also the total amount of the horizontal stress acting on the portion G, L, of the plane G, H; denote this by $h + dh$; then the difference, dh, between the horizontal forces so computed must be equal and opposite to the total amount of the tangential or shearing stress on the horizontal plane K, L. Let z denote the breadth, or horizontal thickness, of the beam at the point K; then the intensity (denoted by T) of the horizontal shearing stress at K is found with accuracy sufficient for practical purposes by dividing the amount of the shearing stress on the plane K, L, by the area of that plane: that is to say,

$$\mathrm{T} = \frac{dh}{z\,dy} \quad \ldots\ldots (1.)$$

Now, according to a principle discovered by Cauchy, the intensities of the shearing stress, at a given point, on two planes at right angles to each other and to the plane of that stress, are equal; therefore the above formula gives the intensity of the vertical shearing stress at the point K of the vertical plane E, F, with accuracy sufficient for practical purposes.

Amongst the consequences of the above solution are the following:—

1. Let O, O, be the neutral surface of the beam, where the horizontal compressive and tensile stresses vanish. The intensity of the shearing stress on any vertical section of the beam, E, F, is greatest at the line N, where that section cuts the neutral surface.

2. The intensity of the shearing stress diminishes when the distance from the neutral plane increases, and vanishes at the upper and under surfaces of the beam, where the horizontal stresses are greatest.

3. In a beam whose cross section is a rectangle, the intensity of the shearing stress at any point in a given vertical section, varies proportionally to the product of the segments into which the point divides the vertical depth of the section; and the maximum intensity is equal to once-and-a-half the mean intensity; that is, equal to three times the vertical load supported at the given section, divided by twice the area of the section.

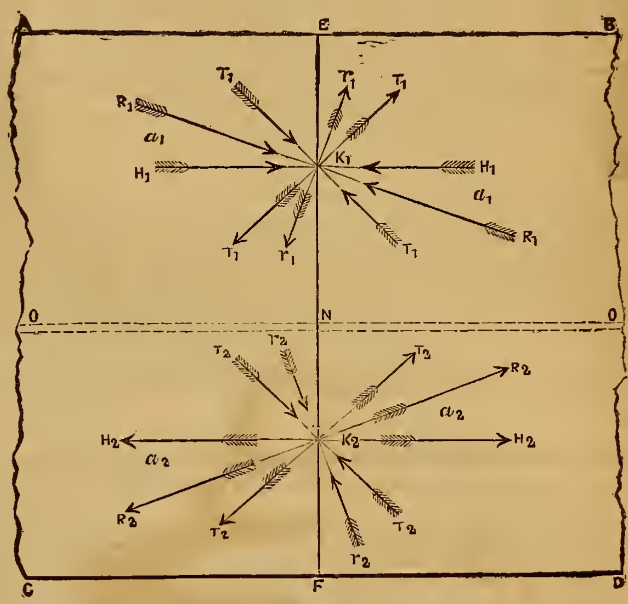


Fig. 2.*

The following is a summary of the method pursued in order to find the result of the combination of the shearing stress with the horizontal compression or tension at a given point.

A shearing or tangential stress is well known to be equivalent to the combination of a compressive stress and a tensile stress of equal intensity, acting at right angles to each other, in directions making angles of 45° with that of the shearing stress which is their resultant. When a vertical shearing stress is combined with a horizontal compressive or tensile stress, the resultant stress consists of two components at right angles to each other; the maximum component being of the same kind (compressive or tensile) with the horizontal stress, and acting in a direction making an angle of less than 45° on the side of the horizontal stress next the component of the shearing stress which is of the same kind. The minimum component of the resultant stress is of the opposite kind (tensile or compressive) to the horizontal stress. The following are the formulæ for computing these components and their directions:

Let H be the intensity of the horizontal stress; T that of the shearing stress; R that of the maximum, and r that of the minimum component of the resultant stress; a the angle between R and H. Then

$$\mathrm{R} = \sqrt{\frac{\mathrm{H}^2}{4} + \mathrm{T}^2} + \frac{\mathrm{H}}{2} \quad \ldots\ldots (2.)$$

$$r = \sqrt{\frac{\mathrm{H}^2}{4} + \mathrm{T}^2} - \frac{\mathrm{H}}{2} \quad \ldots\ldots (3.)$$

$$\tan. 2a = \frac{2\,\mathrm{T}}{\mathrm{H}} \quad \ldots\ldots (4.)$$

The above diagram (Fig. 2) illustrates the manner in which the directions and natures of the components of the resultant stress are determined.

A, B, C, D represents a portion of a beam loaded and supported in such a manner that A, B is compressed and C, D extended, and that the shearing stress at E, F consists in a tendency to depress A, C relatively to B, D. O, N, O is the neutral surface; K_1 a point in the compressed portion of the beam, and K_2 a point in the extended portion.

Compressive stresses are denoted thus ⟶ ⟵

Tensile stresses are denoted thus ⟵ ⟶

and the letters affixed to the arrows have the meanings already explained.

* Want of space compels us to omit the other papers under this section until next month.

* The diagram Fig. 2, instead of a single line O, N, O, has a double dotted line carried across it.

In the vertical longitudinal section of a loaded beam, a net-work may be drawn consisting of two sets of *curves of pressure* intersecting each other at right angles, and indicating, at each point of intersection, the directions of the resultant compressive and tensile stress at that point, as found by equation (4). All these curves intersect the neutral surface at angles of 45°.

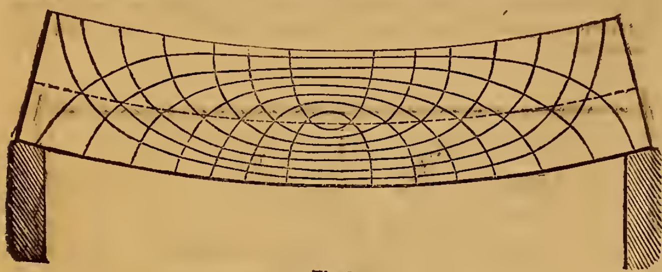


Fig. 3.

Fig. 3 gives a general idea of their arrangement in a beam supported at both ends; the curves of compression being convex upwards, and those of tension convex downwards. The stress which acts along each curve of pressure is a maximum at the horizontal middle portion of the curve, and vanishes at its vertical extremities, except at those points to which the loading and supporting external pressures are directly applied.

The curves of compression are theoretically the best positions for ribs whose object is to stiffen a beam against buckling.

DEATH OF FRANCIS WHISHAW, ESQ., C.E.

We regret to have to record the death of Francis Whishaw, Esq. It is to the zeal and energy of Mr. Whishaw that the Society of Arts stands indebted in a great measure for its resuscitation. He accepted the office of secretary at a time when there were few members to support his exertions, and scarcely any funds with which to meet its expenditure. Owing to his continued personal efforts, backed by the advice and assistance of a few active members whom he gathered around him, he succeeded in instilling new life into the then all but expiring body. His labours to improve the character of the Society's evening meetings, the *conversazioni* he established, and the efforts he made to promote the formation of a National Exhibition of the Industries of Great Britain, brought around him a body of friends and members who, on his retiring from the office in 1845, elected him an honorary life member of the Society. His death took place on the 6th of October, the immediate cause being an attack of apoplexy.

CORRESPONDENCE.

TONNAGE REGISTRATION, STEAM-SHIP CAPABILITIES, &c.

To the Editor of The Artizan.

Sir,—We can ascertain the gravity of gold by means of the balance, its purity by chemical tests, and its other qualities by various specific means; but no one has ever gravely proposed to determine all those different qualities at the same time, by one and the same test. It, therefore, appears to me no absolute standard of excellence—call it "dynamic unit," "co-efficient," or what you will—can, with propriety, be applied to measure the merit of all steam vessels: albeit, this is what Mr. Atherton, and your correspondent, Mr. Armstrong, seem to desiderate.

Ought the same test of excellence to be applied to a steam collier as to a yacht; to an expanded boat, gliding on the Thames or the Hudson, as to a ship intended for ploughing the Atlantic or Indian oceans?

I have had much to do with building and altering steam vessels, and, in every case, have had to deal with definite requirements. Some vessels have to pass over shallow bars, and must, for that and other reasons, be of a limited draft of water; some have to navigate narrow streams; some carry their cargo principally on deck, and therefore require "beam" to keep up their *meta-centre*, and give them stability; some carry such a cargo as keeps the centre of gravity constantly low, and, consequently, admit of being narrower; some must be constructed to "carry canvas," and be good "sea-boats;" and, it must be admitted, *there are a great many others, with regard to which, what may fairly be designated dynamic excellence*, is the desideratum. To the latter, some such formula as Mr. Atherton's or Mr. Armstrong's is applicable. The question then arises, is either of these formulæ correct?

Mr. Atherton assumes that the steam vessel which carries the greatest weight the longest distance in the shortest time, with the best indicated H.P., is the best steam vessel: and, speaking generally, this is not to be disputed; speaking dynamically, it is axiomatic. The water displaced by immersion is exactly the weight to be removed; the miles are measured, our watches give the minutes, and the indicator gives the H.P. It would then appear to be very easy to compare the performance of one steam vessel with that of another.

Putting displacement = D, velocity = V, indicated H.P., I.H.P., then it would seem $\frac{V^2 D}{I.H.P.}$ must be an expression of the dynamic value.

But the comparison of the mere dynamic merit of one vessel with that of another, is perhaps not precisely what is required.

The desideratum is, a rule for calculating what one speed of a vessel ought to be if certain data and the indicated horse-power be given; or what the indicated horse-power ought to be, if the same data and the speed be given. I cannot satisfy myself that the formula proposed by Mr. Atherton, or the table published by Mr. Armstrong, is sufficient for this purpose. Indeed, to devise a formula that would accomplish this *absolutely*, would in my opinion require a mathematical genius transcending Kepler's or Newton's. Newton demonstrated the curve that would generate, upon a given base and axis, the solid of least resistance; but that is a trifling mathematical exercitation compared with a calculation of the resistance encountered by the complex forms of the steamers now afloat. Insuperable difficulties also arise from the propellers employed. The horizontal impulse of the paddle diminishes as the speed of the vessel increases; in short, the effective power of the paddle and screw at all velocities seems almost to defy mathematical analysis. Besides which, it is found that vessels of great speed increase the normal immersion of their after-bodies, arising perhaps from the water not filling up the vacuum they produce in passing through it with sufficient celerity.

Mr. Atherton's formula is $\frac{V^3 D^{\frac{2}{3}}}{I.H.P.} = C =$ coefficient or dynamic value. Doubtless that gentleman has very good reasons, deduced from his own extensive experience, for adopting both expressions in the positive line of this formula. But those reasons are not apparent. Murray, and other eminent engineers, as well as Mr. Atherton, use the *third* power of velocity. And the complicated relationship between the coals expended and the velocity attained may justify them; but the *dynamic* estimate of velocity, disencumbered of all consideration of the apparatus of propulsion, would appear to be its *second* power. This is the doctrine of writers on dynamics, and its truth seems evident, unless we are to class dynamics with the occult sciences. For, put P = the amount of *efficient propelling power* required for a velocity of one mile in any definite time; if we double the velocity, the floating body will impinge upon the water at every part of its transit with twice the force, and therefore will require 2 P for the same distance. But the distance is doubled also; and consequently, 2 P × 2 will be the requisite amount of power for the same time. This is in accordance with V^2, and not with V^3. It does not follow from this that the H.P. of the engines, either indicated or nominal, should be in the ratio of the square of velocity; for notwithstanding the authority of Mr. Armstrong's table, which has it in the ratio, the power transmitted to the crank is modified as to its propelling value by the speed of the vessel. Neither the paddle-wheel nor the screw has so efficient a propelling action at high, as at low, velocities; and there are other modifying influences. The subject under consideration naturally divides itself into two branches; one positive, the other negative. One properly the province of the engineer; the other that of the naval architect. One commencing with the coals consumed, and terminating with the varying efficient force of the propelling instrument; the other comprehending the velocity, dimensions, form, and resistance of the vessel. It is with the latter only that we have to deal in the present disquisition. In examining Mr. Atherton's formula, I should shrink from being dogmatical in opposition to his high authority: but with much deference I submit what appears to me to be evidence of its insufficiency.

The divisor of Mr. Atherton's formula is the aggregated indicated H.P.; C must, therefore, relate to a unit of indicated H.P., and may be treated as a constant. In which case, V^3 and $D^{\frac{2}{3}}$ would be variable terms; and they ought to vary, as the dynamic merits of the floating bodies to which they are applied differ. Now, being co-efficients, one must be increased in the same ratio as the other is decreased: in other words, *the cube of the velocity is inversely as the cube root of the square of the displacement;* thus making displacement the sole measure of the dynamic excellence of a floating body, and utterly disregarding its form and proportions. To this I must demur; because, if it were correct, a steam vessel, having a displacement of 10,000 cubic ft., with a length of 140 ft., and 22 ft. beam, ought to have the same velocity as another having the same amount of displacement, with a length of 110 ft., 25 ft. beam, and a proportionately increased depth: against which all experience abundantly testifies. According to the theory which has the area of the midship section for its basis, the square of the velocity of one vessel would differ from that of the other very considerably: they would be in the ratio of something like 140 to 110; but, as it will soon appear, I have no confidence in that theory. Mr. Atherton's theory, unless I misapprehend it, is pregnant with startling discrepancies. *This data appears to be insufficient.*

Mr. Armstrong's theory is based also upon a striking paucity of data—the midship section merely! The "*midship-section*" theory has the merit of being coeval with steam navigation; it is the pet of a few scientific *quidnuncs*, although generally deemed obsolete; it is patronised by your intelligent correspondent; and it appears in the columns of The Artizan, invested with all the graces that first-rate typography can bestow. I am afraid that but little else can be said in its favour. He must be a bold man who would undertake to calculate, *à priori*, the velocity of a steam-ship, if you gave him the area of her immersed midship section, and concealed from him her shape or length.

The following are perfectly legitimate corollaries, from the theory as laid down by Mr. Armstrong:—

1st. That the area of no transverse section between stem and stern-post is of any consequence to speed, except the area of the section at "*dead flat.*"

2nd. That it is utterly immaterial, as far as speed is concerned, whether a vessel's bottom approximates to a longitudinal section of a rectangular or triangular prism—of a cylinder of a parabolic spindle—whether she is as sharp as the *Banshee*, or as bluff as our old friend of Hamburgh, the *John Bull.*

3rd. That the bulk of the fore and after bodies of a vessel may be increased or diminished, without affecting her speed, provided the midship section remain intact.

It is with hesitation that I treat the question in this *reductio ad absurdum* way; it is one of considerable interest, and deserves grave treatment. My intention is to expose forcibly an erroneous theory; not to annoy its propounder. Mr. Armstrong's table has one apparent advantage over Mr. Atherton's formula—viz., that, although it does not ostensibly recognise the effect of any attenuation of form, it virtually does so, because the area of the midship section would be thereby diminished; indeed, Mr. Armstrong has a remark tantamount to this, but which clashes with his table, and with his assertion that "the midship section is solely the basis for calculations."

I think, then, that no satisfactory calculation can be made of the power required to propel a steam-vessel at any given velocity, if we resolve to use no element derivable from the vessel itself, except the displacement or the area of the midship section. To illustrate this, let Fig. 1 be the horizontal section of a floating parallelopiped, and Fig. 2 be the same, with the four wedges A, B, C, D transferred from its angles to its extremities.

Fig. 1.

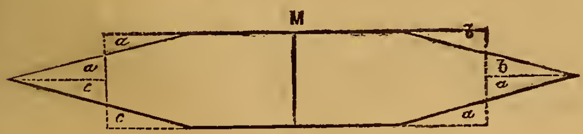


Fig. 2.

The area of the section at M (the midship section) is the same in both, and giving the ends a cuneated form has not affected the quantity of displacement; yet it is manifest that the same power would not propel both through a fluid at the same velocity.

Now, although it is not necessary that we should perplex ourselves with the minute effects of angles of incidence, and tangents of curves, it is obvious that, even for rough practical purposes, we must find in our vessel some element that is great, as her water-lines are favourable to velocity, and small as they are unfavourable; and one presents itself which is very simple, and which can be obtained with the utmost facility—namely, Length. A few facts furnished by my experience indicate conclusively the importance of length.

The establishment with which I am connected have lengthened several steamers at their fore ends, and in every case increased velocity has resulted, although the displacement has been augmented, and the area of the immersed midship section has not been effected. I have known of a vessel being lengthened in Scotland at both ends, with immense advantage both as regards capacity and speed. I am acquainted with several vessels of the highest dynamic excellence, which may be said to have a maximized midship section, but which have fine water-lines and considerable length. The midship section of the *Garland*, Government packet, approximates to a parallelogram; yet what packet of her power will beat her?

I know an instance of the draft of a very successful vessel being submitted to a naval architect, and he produced a superior vessel, by expanding the midship section, and making the lines somewhat finer in the fore body, the displacement continuing the same.

In short, I have always found that increased length gives greater dynamic efficiency with the same area of midship section and quantity of displacement.

Perhaps no formula can be excogitated that would apply rigorously to all steam vessels: those which have a long parallel midship body, and those which have converging lines almost all the way from midships to stem and stern-post, cannot be affected by length to the same extent. Still I venture to suggest *length* as an element of calculation, because if displacement be attenuated by it, diminished resistance results. A paraboloid does not encounter, while passing through a fluid in the direction of its axis, so much resistance as a sphere of the same cubical contents. And, to adopt an extreme illustration, "stem on" is better for speed than "broadside on." Mr. Armstrong will admit that if the midship section be contracted, less power will be required for propulsion. Then, increase length, and the midship section will be diminished—the amount of displacement and capacity for stowage may remain the same. No more need be said, to prove that dynamic excellence may be the result of the great length of defective form, or the result of perfect form; and, therefore, the length must be defined to enable us to discriminate.

The problem to be solved is:—displacement, length, and indicated H.P. being given, What *ought* to be the velocity? Observe, not what *will* be the velocity. The object being to educe a tolerably approximate standard or measure of the dynamic value of the *form* of steam vessels.

Some of your contributors are, doubtless, better qualified to solve this problem, either by pure mathematics or by deduction from accurately reported performances of various steam-vessels, than I can pretend to be; and Mr. Atherton, who laudably interests himself so much in the question, is pre-eminently competent, in both respects, to perform the task. I attempt, for the reasons stated, no solution myself; but content myself with stating that I have some reason for thinking that some fraction of the square root of the length, or some multiple of its cube root, must be used. And the resistance for any displacement will be inversely in the ratio of the quantity produced by so operating upon the length.

The elements proposed can be easily obtained, except the displacement, and I agree with Mr. Atherton in thinking that the builder of every steamer should furnish a statement of her displacement at every foot of draft between the "light" and "load" lines. In my opinion the builder's certificate ought to contain this statement, and that it ought to form part of the vessel's register; because, so furnished, it would be as valid as a legal declaration, and any mis-statement would be punishable by law.

G. J. Y.

THE ARITHMETIC OF NAVAL ARCHITECTURE.

To the Editor of The Artizan.

Sir,—If the science of naval architecture is to remain in *statu quo* until legislative enactments make it compulsory upon shipbuilders and engineers to furnish the necessary data for establishing a system by which the comparative efficiency of steam-vessels may be calculated, then, indeed, the prospect of bringing steam-ship capability within the range of arithmetical calculation is far distant. St. Stephen's is not celebrated for encouraging or fostering the advancement of science, arts, or manufactures; for, be it remembered, that *the* Stephenson was pronounced to be more fitted for a madhouse than for a witness on a railway bill, because, forsooth, he recorded his opinion that a speed of thirty miles per hour on a railway was within the range of probability; and, although it may be urged that such lamentable exhibitions of ignorance on the part of our legislators does not occur now-a-day, you, Sir, and those who are in the habit of attending Parliamentary committees, know that there is still plenty of gross ignorance on scientific subjects, although often studiously concealed beneath a showy and superficial smattering of science and scientific parroting. It is, therefore, not to Parliamentary interference we must look for the elimination of the facts necessary for the purpose of establishing the requisite data; but, Sir, we must rather look to The Artizan, and its extensive and wide-spread influence amongst the classes who *can* supply the necessary information, and who, I feel assured, would do so if they would take the trouble to understand the grave, and not to be over-estimated, importance of the requirement. And it may be well to observe that if data is only to be obtained from builders, engineers, and owners, by compulsion, for fiscal purposes, without some equivalent advantage, I believe that every means which ingenuity can devise will be adopted to defeat that object.

The British shipowner is sufficiently free from charlatanism that, if only a definite object was pointed out, and the conclusions to be derived from the required data were to be expressed in £ s. d. (the most powerful argument), the periodical devoted to the subject would soon be deluged with the necessary information. Lieut. Maury did not require compulsory legislation to compel shipowners to give up their log-books: his object was obvious; the shipowners were consulting their own interest in procuring for him, and in the form suggested, every data that was of importance to his investigations. So it will be with the arithmetic of naval architecture. Let it be exhibited to the shipowner that the object of the required data is to institute a just comparison between the degrees of efficiency of different vessels, as well as between the screw and paddle—between the speed and consumption of coal—between the displacement and consumption of coal—between the expenses of the engine in coals, &c., to both displacement and speed—and between the whole expenses incidental in a vessel to the proportions of the spaces devoted to cargo, passengers, &c.

Such are the important desiderata, which only require the collection of a sufficient number of facts and figures to enable those able and willing to undertake the task, to deduce what is so much desired, and by which *the shipowners would reap the greatest advantage*, in being able to judge of the comparative efficiency of their vessels.

I suggest the following data, as being sufficient to satisfy the wants of every one anxious to arrive at a sound conclusion, viz., the dimensions externally and internally, builder's tonnage, cubical contents of the vessel clear of engine-room and coal bunkers, displacement per inch between light and load water lines, immersed midship section, indicated H.P., consumption of coal, &c., at certain drafts of water, and the speeds of vessels at various drafts under steam only; thus a log-book, ruled and headed for these several particulars, and having them carefully and correctly noted down, ought to be adopted uniformly by all the large steam-ship companies, and a certified copy of each forwarded to you, and when a suitable collection has been obtained and properly arranged, they might be placed before the public in the pages of The Artizan, for scientific investigation, practical criticism, and discussion.

Of the above required data, indicated H.P. is the most indefinite, and the most difficult to contend with; and obtaining accurate statements as to the consumption of coal forms a check upon the indicated H.P., but the midship section, and the rate of steaming, offer the safest data for basing calculations upou; for it appears to me that the practice of engineers is to give too great an indicated H.P., so as to show a small consumption of coal per horse: this should be carefully watched in making calculations.

In the Cornish engines for raising water, the efficiency of the engine is calculated in pounds of water raised 1 ft. high by a pound of coal, without the third element of H.P. Is it not possible that the efficiency of the marine engine could be calculated at the quantity of water displaced by a pound of coal? consequently the indefiniteness of the term H.P. would be superseded; the term H.P. in my ratio of the resistances then would only be dynamically, as a measure of the resistance, calculated at the given rate, and immersed midship section.

It may be possible that I have assumed a ratio of resistance which will bear no comparison in practice; but to exhibit at one view its application, I will take a table (No. 7 in Murray's "Treatise on the Steam Engine") of screw steamers in Her Majesty's Navy, as an illustration, it being only necessary to observe that the ratio proposed by me was obtained from the experience of paddle-wheel steamers.

NAME.	Displacement at trial.	Nominal H.P.	I.H.P. at trial.	Actual Speed per hour.	H.P. for Rate and Mid. Section.	Immersed Mid. Section.	Rate per ratio for I.H.P.	Load on Safety Valve.	Mean Draft of Water.		Diameter of Screw.		Per centage of Speed below standard of efficiency.	Builders.	Engineers.
				Miles.			Miles.	lbs.	Ft.	In.	Ft.	In.			
Ajax	3090	450	843	8·168	529	807	10·2	6	22	6	16	0	20	An old Seventy-four.	Maudslay and Field.
Amphion	2025	300	592	7·71	323	546	10·39	10	19	0	15	0	25	An old Frigate	Miller and Ravenhill.
Archer	1238	200	345	8·934	294	372	9·64	10	14	1	9	0	8	Deptford Dockyard.	Miller and Ravenhill.
Arrogant	2444	360	623	9·48	523	580	10·34	5	18	10	15	6	10	Fincham	Penu.
Bee (Screw and Paddle)	33·2	10	S. 7·796	7·796	17	28·2	,,	,,	3	5	3	1	,,	Symonds	Maudslay and Field.
			P. 8·57	8·57	20										
Blenheim	2790	450	938	6·646	321	738	10·63	10	21	1	16	0	38	An old Seventy-four.	Seaward.
Conflict	1443	400	777	10·616	451	402	13·89	16	14	6	13	6	32	.. ..	Seaward.
Dauntless	2240	580	811	8·418	368	522	12·45	8	16	4	14	8	33	Fincham	R. Napier.
Ditto (lengthened)	2251	,,	1218	11·763	704	,,	15·26	,,	,,		,,		23	,,	,,
Dwarf	98	90	216	12·042	63	44	22·1	8	5	6	5	8	46	Rennie	Rennie.
Encounter	1192	360	672	11·728	435	318	14·53	,,	11	9	12	0	20	Fincham	Penn.
	1290		646	10·714	390	341	13·75	,,	12	6	,,		23		
Fairy	168	128	364	15·227	164	71·5	22·56		4	10	5	4	33	Ditchburn	Penn.
	196		321	13·588	149	82·	19·5	,,	5	10	6	2	31		

This tabulated statement, presents at one view, the trials of various screw vessels, from 33 to 3,090 tons displacement, from 10 to 580 nominal horse-power, and from a royal yacht to a line-of-battle ship; the types are as opposite as it is possible to procure from any public data, and affording sufficient examples to prove that the ratio of the resistances proposed by me as a common standard, are as nearly approximated to correctness as is requisite to prove the value of it as a measure of efficiency. Now, when we consider the time (1848) at which these trials were made, together with the conflicting opinions on the best form of propeller and form of after-body; the variations in the per centage below the standard, from that source, as well as from the screw not being sufficiently immersed, are easy of explanation; the difference in the centage of speed between the *Ajax* and *Blenheim*, between the *Amphion* and the *Dauntless*, and between the *Amphion* and the *Dauntless* (when the latter had been lengthened aft), between the *Arrogant* and the *Dauntless*, as well as the several results below the standard approximating so nearly to the common average, twenty-six, exhibiting the best system of testing the relative efficiency of the engine, and the form of vessel; the *Ajax* and *Blenheim* offer the most striking example of the deficiency of the engine capabilities.

But as these trials may be considered out of date, I will endeavour to produce some modern examples, to show what improvement has been made in the science of naval architecture: and for this purpose, I have collected a stock of data from the columns of The Artizan, and have carefully considered and mentally arranged them for this purpose. I have taken the consumption of coal for duty done as the best criterion of the comparative economy of the engines, and the speed as an index for judging of the efficiency of the vessel for the employment; and here it will be necessary to observe, that the data is not of that sufficient exactness to produce that precise and accurate measure which is aimed at for standard reference; but the system here introduced will be sufficient to prove to the shipowner the necessity of supplying that information which is so requisite to promote the arithmetic of steam-ship capability.

Le Lyonnais.

Builders—Laird and Co., Birkenhead.

Engineers—G. Rennie and Sons, London.

The abstract of the performances of this vessel, given in the August number of The Artizan, only wants the consumption of coal for a given time; say for each watch, more especially when the vessel receives no assistance from the sails, or hindrance from a sea-way, as upon the 17th of June; there are also required statements as to the indicated H. P., immersed midship section, and displacement at the same time, to make that log perfection, the following data being assumed to be correct:—

June 17, take the displacement as	=	2,500 tons.
Immersed midship section	=	500 sq. ft.
Consumption of coal per day	=	42 tons.
Rate per hour	=	12·65 miles.

With these data, the H.P. required for that midship section, and rate, by my formula I. H.P $= \frac{\text{Mid. Sec.} \times V^2}{100}$ is = 800. Consequently, the consumption of coal per horse is 4·9 lbs. per hour, the displacement is carried one mile at the rate of 12·65 miles per hour, by the consumption of 309·8 lbs. of coal, or one ton of displacement is carried one mile by

124 lbs. of coal, or one ton of displacement for one hour at the above rate by 1·568 lbs. of coal.

As a method of testing the efficiency of the vessel by my standard, let the indicated H.P. be measured by the consumption of 4 lbs. of coal per hour, then the H.P. becomes 980, and the proportionate, or corresponding speed, is 14 miles per hour. Hence the *Le Lyonnais* is 10 per cent. below my standard of comparison, a favourable ensample of a screw steamer where the average of the above list is 26 *per cent. below that standard.*

I will now take for example—

The Himalaya.

Builders—Mare and Co.
Engineers—Penn and Co.

with the scanty data gleaned from your columns for her remarkable voyage from Halifax to Spithead, the average rate being 14·72 miles per hour, and assuming ·72 mile per hour for assistance from wind, her midship section at 500, and consumption of coal 78 tons per day (which is giving the vessel every advantage). By my formula, the H.P. required for that midship section, and 14 miles per hour is 980; consequently the consumption of coal per horse is 7·42lbs. per hour, and assuming the displacement at 3,000 tons (at that midship section) which is carried one mile by the consumption of 520 lbs. of coal, or 1 ton by ·173 lb. per mile, or 1 ton of displacement by 2·422 lbs. of coal for one hour. Now, by the 4 lbs. of coal per horse test, the indicated H.P. becomes 1,820, and the proportionate speed 19 miles per hour. Hence *The Himalaya's* efficiency is 26 per cent. below my standard; consequently only of average efficiency, according to the list of screw steamers previously mentioned, and this may be taken as a proof that the science of naval architecture is *not* progressing.

Again, if I take—

The Alliance and *The Havre.*

Builders—Mare and Co.
Engineers—Seaward's Patent Atmospheric Engine.

The average rate of speed of these vessels between Havre and Southampton, is 13·2 miles per hour: average consumption of Welsh coal to Havre and back, including laying by with banked up fires = 24 tons, say 11 tons for the single voyage, 9¼ hours, the midship section 170 sq. ft., and nominal H.P. 220. By my standard the indicated H.P. for that rate, and midship section, is 296; consequently the consumption of coal for that dynamic power is nearly 10 lbs. per horse. Now, applying the 4 lbs. of coal test, the I.H.P. becomes 733; and the rate for that power, and midship section, 20 miles per hour. Hence these two vessels are 34 *per cent. below* the common standard of comparison, which proves that your Southampton correspondent's objections to the engines are well founded.

I will give another example by citing

The Aden, screw steamer.

Builders—Summer and Day, Northam.
Engineers—Summer and Day, Northam.

Displacement at trial	1,205 tons.
Midship section	302 ft.
I.H.P.	900
Draft of water	13 ft. 10 in.
Rate	14·6 miles.

At the trial with the above data the rate *by my standard* should have been 17·3 miles per hour: hence the *Aden* at her trial was 16 per cent. below my proposed standard.

I will now take the voyage from Southampton to Gibraltar and back; the outward voyage being on an average rate of 13·25 miles per hour, and the homeward rate, 12·22 miles per hour; the consumption of coal per hour, 2,520 lbs., and the other data the same as at trial. First for the 13·25 miles per hour, and 302 midship section, we have the standard H.P. 529, or the consumption of coal, 4·76 lbs. per hour per horse, the displacement 1,205 tons carried one mile by 190·18 lbs. of coal, or 1 ton one mile by ·166, or 1 ton one hour by 2·08 lbs., or by the test of taking 4 lbs. of coal for each horse, the rate becomes 14·42 miles; hence the *Aden*, for this example, is only 8 per cent. below the standard.

Again, on the homeward voyage, rate 12·22, midship section 302, we have the standard power 450, the consumption of coal per hour 5·6lb., the displacement one mile by 206·7lb., or one ton of displacement one mile by 171lbs., or one ton of displacement one hour by 2·08lbs.; again applying the 4lbs. test for this passage, the *Aden* is 16 per cent. below the standard.

These examples tabulated will exhibit the various measures of economy and efficiency at one view, according to my standard; but it must be remembered that the data is not of that exact nature necessary to give correct deductions as to the capabilities of the vessels, but it is sufficient to prove that, in supplying the correct information to THE ARTIZAN, it will be possible to produce a system by which every calculation can be made beforehand with the greatest certainty; a desideratum which I contend is not attainable by using Mr. Atherton's formula.

The following is a tabulated statement of the above assumed results.

	Displacement. Tons.	Rate. Miles.	Consumption per standard hour.	Coal, one ton. D. for one mile.	Coal, one ton. D. for one hour.	Per centage below standard.
Le Lyonnais........	2500	12·65	4·90	·124	1·568	10
Himalaya	3000	14·00	7·42	·173	2·422	26
Alliance (Havre)....	,,	13·20	10·00	,,	,,	34
Aden (outward)	1204	13·25	4·76	·166	2·08	8
Aden (homeward) ..	1204	12·22	5·60	·171	2·08	16

As these examples of the screw propeller are all below the standard, according to the system proposed by me, and as it has been previously stated the standard is taken from performances of paddle-wheel steamers, I will introduce a few vessels in Her Majesty's navy and the Post-office service as examples, the types being as various as before; and from the nominal H.P. and medium, or mean speed under steam only, deduce the proportionate immersed midship section by my formula; mid. sec. $= \frac{\text{I.H.P.} \times 100}{V^2 \text{ miles}}$, to which I direct the attention of such of your readers as are able to procure the data necessary to test fully the correctness of the formula and standard of comparison.

NAME.	Tonnage O.M.	Nominal H.P.	Rate Miles.	Pressure in boiler.	Mid. Sec.
Acheron............	722	160	9·14	6	191
Bulldog............	1124	500	10·8	7½	430
Black Eagle........	540	261	12·85	10	158
Caradoc	650	350	13·7	12	187
Dasher	260	101	10·3	8	95
Echo	295	140	9·7	5	149
Fearless............	165	76	9·14	4	91
Garland	300	124	14·3	16	60
Harpy	345	150	9·14	8	179
Inflexible	1122	379	10·3	14	357
Jackall	340	150	9·14	10	179
Kite	300	150	9·43	4	169
Lightning..........	296	100	9·14	6	119
Magicienne	1220	399	11·4	14	307
Oberon	650	260	10·3	10	245
Penelope	1626	625	10·8	10	536
Princess Alice	270	117	14·3	16	57
Retribution	1640	399	11·4	14	307
Sidon..............	1328	560	11·4	10	430
Terrible............	1850	829	12.55	7	531
Victoria and Albert	1034	420	12·43	10	273

These deduced proportionate midship sections to nominal H.P. present the basis of a system for investigation, the results by which are so nearly approximated to in practice. To a naval architect there is nothing inconsistent in them, when the pressure of steam in the boiler is taken into consideration; at a glance they would be pronounced nearly correct; and I ask, Will the coefficients derived from displacement produce such an uniformity of results in vessels of such various types? nay, it is quite possible with that formula, by making the speed constant, to alter the displacement and indicated H.P. in such a manner, to make the same coefficient correspond to the most opposite of vessels, and which would have no comparison in practice.

By the system here proposed, the efficiency of the vessel is divided into separate parts, instead of the whole being summed up in an unintelligible coefficient, which can have no real commercial value; for here we have the comparative economy of the engine tested by the consumption of coal per H.P., the economy of the vessel by the quantity of coal required to propel 1 ton of displacement a given distance, and the efficiency of the vessel by a common standard of resistance, for every rate; by such division the merits of the vessel or engine can be exhibited each at its proper value, and will show in how many instances, amongst the previous examples, can the commercial *non-efficiency of the vessel* be traced to the engine, and in how many others to the *form of the vessel.*

Can it be possible, after the numerous sums which have been expended in discovering the *solid of least resistance*, that one formula is suitable in every description of vessel for the calculation of speed; if possible, what becomes of all those splendid speculations about straight, convex, concave, parabolic, or wave waterlines, which so many of our naval architects have been attempting to prove to be the solid of least resistance?

In the midst of such a diversity of opinion among naval architects on the subject, I challenge any one to point out a single established principle or fact in the whole range of the sciences of mechanics or hydrostatics, that points to any other conclusion, but that the solid of least resistance is that body which presents the smallest section to the line of motion; and to those engaged in the practice of naval architecture, to point out where great speed is obtained, that it is not always on the side of the small midship section for length, and increased steam power above the ordinary proportion of other steam-ships.

There is one important point which requires consideration, and which has not been clearly or accurately dealt with, viz., the immersed midship section of a vessel being given when she may, in fact, be floating "by the stern," and not on even keel; and the mean midship section may be given as the data, which, be it remembered, will not give the correct area of the section to that volume of water which a vessel may be supposed to displace in sailing a given distance, but which is entirely the basis of these calculations, for in a vessel floating by the stern to the extent of—say two feet—the difference arising therefrom as compared with a flat bottom, and the section presented to the line of motion, might be safely estimated at an increase of six inches for the depth, and thus form a most important element to be taken into consideration in these calculations.

In my investigations for measuring the comparative efficiency of vessels, I have found invariably at the higher rates, a greater per centage below the standard than in the lower rates. A most important question then arises. Do the resistances increase at a greater ratio than the square of the velocity? Or is it caused by the vessel's stern falling into that vacuum which necessarily takes place at the higher velocities, increasing the section to the line of motion on which the efficiency is calculated upon? My opinion inclines to the latter; and, if it be so, a question might suggest itself, viz., Would the vessel's speed be increased by loading her by the head, so that when at her speed the vessel would be on an even keel? and it is certainly an experiment worthy of trial. The memorial of the British Association to the Admiralty, asking for the complete publication, in a minute form, of the results of the trials of Her Majesty's steam ships, must be pressed for. It is by means of such trustworthy data that the science of naval architecture, and the arithmetic of steamship calculation will be brought to a satisfactory state; but whether the required data is to be procured by Parliamentary influence, from the Admiralty department, or from private sources, the data from trials at the measured mile, is not of that order of character suited to give the *real working* or *commercial efficiency* of the vessel. Data derived from continuous working, and extending over greater distances, and with the consumption of coal accurately detailed, instead of taking the indicated H.P., will be more valuable for the purpose of forming accurate conclusions upon, and by which we may hope for the establishment of a simple and accurate system of measuring the comparative economy and efficiency of steam-propelled ships.

I am, Sir, &c., R. Armstrong.

SHIP BUILDING, ETC.

To the Editor of The Artizan.

Sir,—In the Artizan of this month your correspondent, Mr. Armstrong, advocates the use of machinery in ship building; but, apparently, he is not aware that it has already been extensively used in Portsmouth and other dockyards, though not by private ship-builders. In the year 1797, Sir Samuel Bentham proposed to the Secretary of the Admiralty various machines of his invention, which, accordingly, were successfully introduced at Portsmouth, and afterwards at other royal dockyards; and in 1812 he proposed machinery to a great extent for Sheerness Dockyards: the savings by its use were shown to have been immense, as published in his "Statement of Services;" and, doubtless, they would be enormous in a private yard, but as is said by your correspondent, no private capital would suffice for its expense.

Oct. 10, 1856. I am, Sir, yours truly, M. S. Bentham.

BOURNE'S BOAT TRAINS FOR INDIAN RIVER NAVIGATION.

To the Editor of The Artizan.

Sir,—The Artizan of this month, in speaking of the internal communication in India, mentions Mr. Bourne's steam vessel; and as there existed some doubts as to the feasibility of *jointed*-vessels, I can assure you that their perfect success has been verified. Sir Samuel Bentham constructed similar vessels at Dubrowna. One of these vessels was named the *Imperial Vermicular*, and drew but 6 in. of water when loaded: others were used for the conveyance of manufacturing and agricultural produce to the Black Sea. Mr. Bourne, through a friend, had many communications with me on the subject of them. We attempted several years ago to ascertain whether any of those vessels still existed, but in vain. One old man, however, was found through our ambassador, who recollected them. The wood of these vessels being valuable at the mouth of the Dnieper, they were broken up there. The English Ambassador at St. Petersburg, Lord St. Helens, and the French one, Count de Segur, were both of them on board the *Imperial Vermicular*, as also the Emperor Joseph II. of Austria. His Majesty witnessed its peculiar capabilities, for Sir Samuel had the head of the vessel fastened to the stem, so as to form a complete ring; and when disconnected, it straightened again. This mode of construction is evidently suitable for the navigation of tortuous rivers, and Mr. Bourne has added the means of drawing over dry sand banks.

Oct. 16, 1856. I am, Sir, yours truly, M. S. Bentham.

LIST OF NEW BOOKS OR NEW EDITIONS OF BOOKS.

IMRAY (J.)—Practical Mechanics; including Mechanical Drawing, Strength of Materials, and Sources of Mechanical Power. By James Imray. Post 8vo, pp. 142, cloth, 1s. 6d. (Houlston.)

ORR'S CIRCLE OF THE SCIENCES, VOL. VIII.—Practical Chemistry; including the Theory and Practice of Electro-Deposition, Photographic Art, the Chemistry of Food, with a Chapter on Adulterations; and the Chemistry of Artificial Illumination. By George Gore, Marcus Sparling, and John Scoffern. Post 8vo, pp. 552, cloth 5s. 6d. (Houlston.)

SCOFFERN (J.)—Chemistry of the Inorganic Bodies; their Compounds and Equivalents. By John Scoffern. Post 8vo, cloth, 3s. (Houlston.)

WELLS (D. A.)—Science Popularly Explained; the Principles of Natural and Physical Science, and their Practical and Useful Applications to the Employments and Necessities of Common Life, familiarly explained. By David A. Wells. Post 8vo, pp. 560, cloth, 3s. 6d. (Cassell's Educational Course.) (Kent.)

BOURNE (J.)—Public Works in India; being a letter to the Right Hon. R. V. Smith. By John Bourne. 8vo, sewed, 2s. 6d. (Longman.)

BRANSTON (T. F.)—Cyclopædia of Practical Receipts; a Manual for the use of Private Families, Chemists, &c. By Thomas F. Branston. New edit., 12mo, pp. 260, cloth, 3s. 6d. (Ward and Lock.)

MARETT (P. R.)—Yachts and Yacht-Building; being a Treatise on the Construction of Yachts, and other matters relating to Yachting. By P. R. Marett. 8vo, pp. 92, cloth, 6s. (Hunt.)

RICHARDSON (W.)—The Railway Drawing Book; consisting of a Series of Drawings of Engines, Tenders, and Passenger Trains, Signals, Goods and Cattle Trains. Drawn on Stone by William Richardson. Parts 1 and 2, oblong, sewed, 1s. each. (Dufour.)

*LAFEVER (M.)—The Architectural Instructor; containing a History of Architecture from the Earliest Ages to the Present Time. By Minard Lafever. Royal 4to (New York), pp. 526, with 250 engravings and 112 plates, partly coloured, half-morocco. London, £5.

* All preceded by an Asterisk are new American Works.

NOTES AND NOVELTIES.

White's Slips for Hauling-up Ships.—Mr. Thomas White, junior, of Portsmouth, has introduced several improvements in slips and ways for receiving ships requiring repair, and in apparatus for hauling up such slips. His invention relates, firstly, to an improved mode of constructing the longitudinal inclined way up which a ship or vessel requiring repair is drawn out of the water by suitable machinery, so as to place it on dry ground, in order that the bottom of the vessel may be examined with facility, and repaired when required. In ordinary slips the way is provided from end to end with rails, which extend down in one uniform incline to such a depth below water as will admit of the cradle or carriage on which the vessel is to be supported (when out of the water) being carried down under the vessel. In carrying the way down in one uniform incline, the excavation required to admit of this is so deep as very greatly to increase the cost of constructing the slip; and in some cases the difficulties experienced in effecting this object would involve so great an expenditure that the undertaking has frequently to be abandoned. Mr. White, however, instead of arranging the rails down to the bottom of the slip at the same incline, proposes to carry them down only to a point a little below the head of the vessel to be operated upon; for instance, supposing the slip is intended for a vessel not exceeding a given tonnage, and having a draught not exceeding, say 12 ft., he carries the inclines down to that point, and then curves the way beyond that point so as to bring the end of the rails to a horizontal, or nearly horizontal position. The carriage or cradle which, from its construction, readily accommodates itself to the level of the rails, may then be lowered down the slip and placed under the floating vessel; and when the vessel is secured in it, hydraulic or other power is applied to draw it up out of the water. The second improvement relates to the arrangement of the upper part of the slip or way, or that part upon which vessels are intended to be placed while under repair, the object being to increase the capacity of the slip for receiving vessels on their cradles. With this view Mr. White constructs, at any convenient part of the upper way, a lateral way on one or both sides of the longitudinal way, and at right angles thereto; and he connects the two ways together in such a manner that when the carriage with the vessel thereon is brought up to the point of junction on the longitudinal way, it may be moved laterally off that way, so as to admit of other vessels being carried past, if required. The lateral ways may be extended, so as to receive any number of vessels which may, when out of use, be laid up out of the water; or these ways may, in their turn, communicate with ways parallel to the main way, and thus afford increased means for stowing away vessels. The third part of the invention relates to the apparatus for hauling up slips or vessels, and consists in the employment of a second or runner chain, by which the power of the hauling-up machine or motive-power is to be doubled, without occasioning any additional stress upon such machine.

The Bessemer Iron.—Bessemer's patent rail, lately rolled at Dowlais, was subjected to pressure under the deflecting machine. The bearings were 3 feet apart. After bearing 12 tons weight, the arc of deflexion did not appear deeper than that in ordinary rails with a load of only two-thirds the weight; and, on being relieved, the rail recovered its original straight line. This proves that the Bessemer rail is possessed of tenacity and elasticity equal, if not superior to those of the usual manufacture.—*Star of Gwent.*

Artificial Light for taking Photographs.—A very brilliant light has been produced by directing a stream of oxygen gas into the flame of coal gas which had been previously passed through cotton and naphtha in order to surcharge it with carbon. With this light, using a reflector, a photograph of an engraving was taken by the camera in a very short period.

The Great Eastern Steam Ship.—The first of the ten boilers for the *Great Eastern*, building at Scott Russell's works, was, on Tuesday, lifted from the ground, over the vessel's deck, a height of upwards of 60 ft., by the steam travelling crane erected for that purpose, and safely deposited in its new home in the ship's hold. Its weight is 38 tons, and the process of raising and lowering was accomplished in two hours.—*Oct. 23rd.*

Australian Railway.—The step taken by the South Australians in opening up the navigation with the river Murray—which has been most successfully accomplished for some time past, after various difficulties being overcome—having seriously excited the apprehensions of the commercial interest and the inhabitants generally, will give increased energy to the efforts for making a railway from the metropolis to the goldfields in the northern districts. Soon after the discovery of gold, when the necessity arose for conveying large quantities of stores to various parts of the interior to feed the suddenly-located population, the absence of all means of communication pressed heavily upon all concerned. In consequence thereof certain railways were projected, the chief of which was that which was to commence at Melbourne, and running thence to Mount Alexander, terminate on the banks of the river Murray. On the estimated cost of this work—viz., £1,000,000, the Colonial Government consented to guarantee 5 per cent. interest for twenty-one years, gave the Company fifty acres of land at the west end of the town, and eleven acres at Williamstown for termini, and all the land belonging to the Crown which the Company might require. The Legislature also authorised a gift of £5,000 in aid of the preliminary surveys. With all these advantages the Company has only been able to raise £65,000, one-third of which has been expended unproductively. Seeing this, the Government has just completed the purchase of all the rights, privileges, and property of the Company, giving in payment for the same 5 per cent. debentures, redeemable at par at the expiration of fifty years. This newly-acquired and novel description of Government property is vested in two officers of the Government, for and on behalf of the colony. These gentlemen have it in contemplation to push on the works with every possible despatch, and as a preliminary, have ordered by the last two mails respectively, about £60,000 worth of plant.—*Australian and New Zealand Gazette.*

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 18th July, 1856.

1690. W. Leuchars, 38, Piccadilly—Locks for travelling bags.

Dated 21st August, 1856.

1954. W. Heap, D. Sharp, and G. Knowles, Bradford—Furnaces for economizing fuel and preventing smoke.

Dated 25th August, 1856.

1982. G. Warriner, Withernsea, Yorkshire—Compounds for preserving, deodorizing, and fertilizing.

Dated 26th August, 1856.

1993. S. Jay and G. Smith, 246, Regent-st.—"Facing" or covering to be attached to the outside of ladies' dresses, mantles, &c.

Dated 27th August, 1856.

1995. J. M. Giresse, St. Macaire, France—Machine to mince tallow and meat.

Dated 28th August, 1856.

2003. C. D. Gardissal, 10, Bedford-st., Strand—Treating and preparing sea-weeds for manure.
2005. R. A. Brooman, 166, Fleet-st.—Improvements in shuttles.
2007. T. Watson, Poland-st.—Improved beer-engine lever.
2009. J. B. Feauveau and L. A. Legrand, Brussels—Apparatus for the purification and the combustion of gas.

Dated 29th August, 1856.

2013. J. Brown, Pendleton, Lancashire—Swinging hammocks, and in the construction of bedsteads, &c.

Dated 30th August, 1856.

2014. J. and W. Fletcher, Salford—The construction of weighing cranes.
2015. J. H. Johnson, 47, Lincoln's-inn-flds.—Improvements in fire-arms.
2016. J. Blake and F. Maxwell, Kitchen-st., Liverpool—The manufacture of soap.
2017. A. L. A. Herbelot, Paris—Obtaining motive power by gases or fluids.
2019. J. Pope, Canterbury—Mode of cultivating and treating the hop plant.
2020. C. Goodyear, Leicester-sq.—Combining gutta percha and asphalt.
2021. H. Conant, Connecticut, U.S.—Improvements in fire-arms.
2022. D. Sutton, Banbury—Manufacture of cast-iron cooking kettles.
2023. J. Gregory, Nelson-sq.—Fish joint.
2024. M. Bower, R. Peyton, and J. W. Downing, Birmingham—Metallic bedsteads, &c.

Dated 1st September, 1856.

2025. G. Hamilton, Blackland Mill, Paisley, N.B.—Finishing of textile fabrics.
2026. M. E. Bowra, 63, Basinghall-st.—Placing of rails for railway and other purposes.
2027. T. P. Hawkins, Birmingham—Manufacture of wire chain.
2029. R. H. Norris, M.D., 46, Stafford-st., Birmingham—Improvements in photography.
2030. A. V. Newton, 66, Chancery-la.—Charger for shot-pouches.
2031. E. H. Cradock Monckton, 77, Chancery-la.—Blast furnaces for smelting ores.
2032. F. Levick, jun., Cwm Celyn and Blaina Iron Works, Monmouth—Construction and working of blast furnaces.

Dated 2nd September, 1856.

2034. M. Aron, 39, Rue de l'Echiquier, Paris—Improved leaven.
2035. A. Archer, Old Swan, Liverpool—Preparing for use "founders' charcoal blacking," "coal dust," "loam," and "facing sand."
2036. J. Bate, Birmingham—Improvements in folios, clips, &c.
2037. J. Apperly, Dudbridge, Stroud—Process of preparing cotton, &c., for spinning, and in carding and preparing machinery.
2038. P. J. Guyet, Paris—Method of stopping railway carriages and trains.

Dated 3rd September, 1856.

2039. G. C. Thomas, 67, Gracechurch-st.—Method of making steel.
2040. J. Lamb, Manchester—Machinery for preparing, slubbing, and roving cotton, &c.
2042. S. Hallen and E. Hallen, Cornwall-rd., Lambeth—Rolling metallic substances.
2043. J. Metcalf, Newton Heath, near Manchester—Manufacture of tar oil for dissolving India-rubber, and in deodorizing all fabrics impregnated with tar oil.
2044. L. Cornides, 4, Trafalgar-sq.—Preparing hides, skins, intestines, &c.
2045. S. Ghidiglia and L. Turletti, 39, Ruel' Echiquier, Paris—Improved buckle.
2046. E. P. Spiller, Holborn-hill—Construction of chamber lamps.
2047. J. Roberts, Upnor, Kent—Stoppering of jars, bottles, &c.
2048. J. Mozard, 6, Dufour-pl., Golden-sq.—Construction of miners' lamps.

Dated 4th September, 1856.

2049. J. Picken, Dunlop, Ayr, N.B.—Arrangement of the feed apparatus of machines for threshing grain.
2050. W. Bishton, Wolverhampton—Boats for inland navigation.
2051. T. Morrison and S. Amphlet, Birmingham—Fastening for belts, bands, &c.
2052. C. J. Dumery, Paris—Steam engines.
2053. J. T. Hart, 67, Gracechurch-st.—Apparatus for modelling statuary from life.
2054. E. and G. P. Leigh, Manchester—Parts of machinery used in preparing and spinning cotton, &c.
2055. G. A. Lewis, Bristol—Disconnecting and raising screw propellers.
2056. E. A. Roy, J. A. Hall, and W. T. Binns, Camden-tn.—Means of insuring draught in smoke flues.
2057. W. Keates, Liverpool—Process of reducing copper to the metallic state from ores and other materials containing copper, and in the furnaces employed therein.
2058. G. Anderson, Queen's-rd., Dalston—Combustion of tar in heating gas retorts.
2059. Capt. J. M. Hayes, R.N., Southsea—Construction of cartridges for fire-arms.
2060. W. Moberly, Ravenhead, Lancashire—Grinding and polishing of curved and rounded surfaces.
2061. J. L. Tahbener, 4, Trafalgar-sq.—Smelting ores.
2062. B. O'Neale Stratford, Earl of Aldborough, Stratford-lodge, Wicklow, Ireland—Aerial navigation and apparatus connected therewith.
2063. R. A. Brooman, 166, Fleet-st.—Construction of buildings.

Dated 5th September, 1856.

2064. J. B. Dancer, Manchester—Photographic cameras.
2065. H. E. C. Monckton, Parthenon Club, Regent-st., and W. Clark, Upper-ter., Islington—Machinery for tilling the soil.
2066. J. Johnson, Single-st., Mile-end—Railway carriages.
2067. A. E. Duchateau, Paris—Stamp presses.
2068. W. S. Mitchell, Cornhill, and C. M. E. Gartner, Lower Ashby-st., Northampton-sq.—Construction of watches.
2069. R. Reeder, Cincinnati, U.S.—Universal dial and chronometer compass.
2070. R. Wilson, Patricroft, Lancashire—Valves.
2071. T. Burstall, Southall, Middlesex—Machinery for manufacturing bricks and tiles from clay.
2072. J. Johnston, Ohio, U.S.—Photographic plates.
2073. C. L. F. Helrigel, 6t. James-st., Bedford-row—Lithographic printing presses.

Dated 6th September, 1856.

2074. H. Dyer, Plaistow, Essex, and G. Dyer, Gracechurch-st.—Freeing textile fabrics from impurities.
2075. J. Anelli, 2, Talbot-villas, Paddington—A crampon to prevent horses slipping in frosty weather.
2077. J. Juckes, Dame-st., Islington—Improvements in stoves.
2078. G. P. Harding, Kingsland—Manufacture of hats.
2079. P. Wright, Dudley, Worcester—Manufacture of anvils.
2080. A. V. Newton, 66, Chancery-la.—Machinery for cutting round files.
2081. C. L. Lapito, 2, High-st., Marylebone—A machine for manufacturing of mortar and concrete.
2082. W. Wilkens, Baltimore, U.S.—Revolving cylinder battery.
2083. P. Armand le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Making artificial stones for statues.
2084. H. E. Trottier, 39, Rue de l'Echiquier, Paris—Improved portable bath.
2085. P. R. Hodge, Albion-grove, Islington—Grinding wheat and other grain.

Dated 8th September, 1856.

2086. T. Craig, Glasgow—Ruling paper.
2087. F. Estivant, Paris—Casting metal tubes.
2088. A. G. Chalus, Paris—Improvements in stopping bottles and other vessels.
2089. J. Fowler, jun., Havering, Essex—Machinery for ploughing and tilling land by steam.
2090. A. Dalton, Chester—Smelting ironstones and ores, and in furnaces used for that purpose.
2091. R. Bamford, Preston—Looms for weaving.
2093. F. M. Herring, Basinghall-st.—Applying magnetic action to combs and brushes.
2094. T. Restell, New Kent-rd.—Breech-loading fire-arms and ordnance.
2095. W. Petrie, Woolwich—Manufacture of sulphuric acid and the apparatus employed therein.
2096. A. V. Newton, 66, Chancery-la.—Machinery for cutting India-rubber and other substances into threads or narrow strips.

Dated 9th September, 1856.

2097. J. Watson, 30, Tureen-st., Glasgow, and C. F. Halle, Manchester—Spinning or twisting fibrous materials.
2098. W. Pidding, Trinity-ter., Southwark—Preparation and manufacture of certain piled, corded, or other fabrics.
2099. H. Cunningham, Pitarthie, Fife, Scotland—The production of blanks for bank notes, bills, checks, treasury bonds, script, stocks, &c., to prevent counterfeiting, &c.
2100. W. Gossage, Widnes, Lancashire—Manufacture of certain kinds of soap.
2101. R. A. Brooman, 166, Fleet-st.—Apparatus for sprinkling substances in a state of powder.
2102. C. Brook, jun., Meltham Mills, Huddersfield—Polishing or finishing yarns, threads, and woven fabrics.
2105. W. Smith, 10, Salisbury-st., Adelphi—A powerful compound whistle.

Dated 10th September, 1856.

2106. H. Cooke, Manchester—Dyeing yarns or threads.
2107. C. W. Siemens, John-st., Adelphi—Electric telegraphs and apparatus.
2108. A. Robert, La Villette, near Paris—Process of treating, smelting, and refining copper, tin, &c.
2109. H. D. P. Cunningham, Gosport, Hants—Improvements in reefing sails.
2110. G. Riley, 1, The Grove, South Lambeth—Mode of treating maize for distilling, with apparatus therefor.
2111. J. Neuenschwander, canton of Bern, Switzerland—Processes of preparing milk to be preserved.
2112. H. Gilbee, 4, South-st., Finsbury—Manufacture of iron.
2113. J. Taylor, Spring-grove, Hounslow—Building walls.
2114. J. C. Davidson, Yalding, Kent—Construction of share drill.
2115. S. White, Newlands-st., Everton, Liverpool—Method and apparatus for the distillation of certain oils, and method of purifying the oils.
2116. J. C. Davidson, Yalding, Kent—Construction of hop bin or frame.
2117. W. Webster, 22, Bunhill-row—Troughs for feeding animals.
2118. J. H. Johnson, 47, Lincoln's-inn-fields—Machinery for making bricks.
2119. W. Oldham, Southam, Warwick—Manufacture of cement, and preparing colouring matter for cements.
2120. W. H. Forster, Gravesend—Fastening for articles of jewellery.

Dated 11th September, 1856.

2121. J. B. Robinson, Beverley, Yorkshire—Machinery for effecting agricultural operations.
2122. J. Gedge, 4, Wellington-st. South, Strand—Colouring matter applicable to coating metals.
2123. J. Hudson, Halifax—Setting "printers' doctors," and other straight-edged tools.
2124. P. A. Balestrini, Brescia, Italy—Protecting and laying telegraphic wires.
2125. R. A. Coward, Lawrence Pountney-la.—Paddle wheels for propelling vessels.
2126. J. Milnes and W. Thompson, Sutton Mill, Kildwick, Yorkshire—Looms for weaving.
2127. L. E. Truesdell, Warren, Massachusetts, U.S.—Weight distributing bridges.
2129. A. Chaplin, Glasgow—Improvements in ships.

2130. A. D. Bishop, Hanover-house, Charlton, Kent—Derricks for raising sunken ships, &c.

Dated 12th September, 1856.

2132. W. S. Clark, Camden-town—Hydraulic heaters.
2133. J. J. Leaver, 17, York-st., Rotherhithe—Improved pump.
2134. J. T. Pitman, 67, Gracechurch-st.—Repeating fire-arms.
2135. J. Koronikolski, 36, Lisle-st., Leicester-sq.—Baking ovens.
2136. H. Dubs, Vulcan Foundry, Warrington, and J. Evans, Haydock, Lancashire—Slide valves.
2137. E. Paton and C. F. Walsh, Perth, N.B.—Fire-arms and projectiles.
2138. I. Leys, Dunkerque, France—Preservation of cheese.
2139. G. Hutchinson, 160, Hope-st., Glasgow—Treatment of oils and fats.
2140. J. Elliott, Southampton—Apparatus for containing and supplying water, gas, and other fluids.
2141. R. A. Brooman, 166, Fleet-st.—Treating and purifying water to be used in the washing and scouring of wool.

Dated 13th September, 1856.

2143. W. Whittle, Smethwick, Staffordshire—Machinery for the manufacture of nails.
2144. R. Peyton, Birmingham—Manufacture of metallic bedsteads.
2146. J. S. Vaughan, Stockland Vicarage, near Bridgwater—Apparatus for making infusions of vegetable or other substances.
2147. F. D. Monod, Marseilles—Manufacture of chlorine.
2148. R. A. Brooman, 166, Fleet-st.—Improvements in mills.
2149. C. Hill, G. W. Railway, Chippenham Station—Manufacture of lubricating matters.
2150. S. C. Lister, Manningham, near Bradford, York—Preparing and spinning cotton, flax, and similar fibres.
2151. J. Buchanan, Katrine, Ayrshire, N.B.—Propelling vessels.

Dated 15th September, 1856.

2153. J. Knowelden, Southwark—Arrangement of valves and apparatus for preventing steam-boiler explosions.
2154. J. B. J. Lassie, 39, Rue de l'Echiquier, Paris—Aerial navigation.
2155. C. F. Clements, Liverpool—Separating copper and other metals from ores containing them.
2156. C. Kline, Brooklyn, New York, U. S.—Mariners, and other compasses.
2157. G. C. T. Canstoun, Chirnside-bridge, G. Young, Dunse, and J. Lovell, Chirnside-bridge, Berwick, N.B.—Application of steam for producing a boiling action in bleaching, &c.
2158. A. Rowand, Glasgow—Cases or vessels for holding gunpowder.
2159. S. Chodzko, Paris—Manufacture of manure and the apparatus employed therein.

Dated 16th September, 1856.

2160. R. E. Garrood, Chelmsford—Stopcocks and valves for the drawing off and passage of air, gas, steam, water, and other fluids.
2161. A. V. Newton, 66, Chancery-la.—Preparation of phosphoric acid.
2162. A. V. Newton, 66, Chancery-la.—Apparatus for raising water by atmospheric pressure.
2163. R. Walker, jun., 62, Buchanan-st., Glasgow—Ascertaining the draught of water and trim of ships.
2164. R. Lavender, Aldersgate-st., and E. Lavender, Aston-st., Limehouse—Raising water and other fluids, and in obtaining power thereby.
2165. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Power looms for weaving wire cloth.
2166. R. A. Brooman, 166, Fleet-st.—Water-closets and night stools.
2167. J. Elliott, Southampton—Taps and cocks.
2168. R. Mushet, Coleford, Gloucester—Manufacture of iron.
2169. R. Mushet, Coleford, Gloucestershire—Smelting of iron ores.
2170. R. Mushet, Coleford, Gloucester—Manufacture of iron.
2171. J. G. Martien, Newark, New Jersey, U.S.—Manufacture of iron.

Dated 17th September, 1856.

2172. R. Burns, Liverpool—Improvements in bone mills.
2173. C. Marsden, Kingsland-rd.—Fastenings for shirts, and improved tag, &c.
2174. D. Crichton and J. Cathcart, Manchester—Looms for weaving.
2175. J. Barber, Manchester—Machinery for mill and other engraving, punching, &c., and mandril used in mill, eccentric, and other machinery employed in engraving rollers for printing, &c.
2176. A. Andraud, Paris—Improvements in wheelbarrows.
2177. W. F. Spittle, Birmingham—Spindle for braiding and plaiting machines.
2179. C. H. Schroder, Altona, Holstein—Improved rotary engine.
2180. G. Davies, 1, Serle-st., Lincoln's-inn—Apparatus for actuating railway breaks.
2181. F. H. R. Scheller, Vienna—Manufacture of illuminating gas.
2182. J. M. Hetherington and J. Gee, Manchester—Flyers for preparing cotton and other fibrous substances for spinning.

Dated 18th September, 1856.

2183. I. Baggs, Manchester-st., Argyle-sq.—Smelting copper and other metals from their ores, and the manufacture of sulphuric acid by such process.
2184. T. C. Hinde, Birmingham—Manufacture of iron.
2185. T. Horrex, South-sq., Gray's-inn—Apparatus to facilitate the delivery of coals to cellars.
2186. L. Jacquemier, Rome—Method of hardening and colouring alabaster and other gypsums.
2187. G. Hill, City-rd., Derby—Feeding steam-boilers.
2188. A. G. Guillaumin, Paris—Improved ramrod.
2189. R. Wilson, Oxford-ct., Salters' hall—Construction of fire-proof floors and ceilings.
2190. W. F. Plummer, St. Mary's Overy Wharf, Southwark—Mode of preparing hard wheat and other hard grain for grinding.
2191. T. Greenwood, Leeds—Machinery for trimming the teeth of wheels.
2192. W. H. Cooper, Manor-cottages, Bromley-hall—Manufacture of fretwork for ornamental windows.
2193. C. Goodyear, jun., Leicester-sq.—Manufacture of penholders and handles for penholders.

Dated 19th September, 1856.

2194. J. B. H. de Roussen, 39, Rue de l'Echiquier, Paris—Apparatus for washing and cleansing ores.
2196. C. F. Vasserot, 45, Essex-st., Strand—Filtering water on a large scale.
2197. J. Smale, Gibraltar-row, Southwark—Apparatus for transferring designs or letters on to glass.
2198. P. Laffitte, Paris—Engine with rotary piston.
2201. A. Clark, 83, High-st., Southampton—Signal lamps.
2202. W. Young, Queen-st., Cheapside—Furnaces, fire-places, and stoves.
2203. E. Finch, Bridge Works, Chepstow—Construction of wrought-iron masts, bowsprits, yards, &c., and in rigging ships.
2204. G. Dawes, Union-st., Southwark—Manufacture of hats.
2205. R. Van Hees, Manchester—Construction of electric clocks or time-keepers.

Dated 20th September, 1856.

2207. J. Sherar, Aberdeen—Oil and spirit lamps.
2208. R. Van Hees, Manchester—Construction of wrought-iron wheels for railway and other purposes.
2209. J. Naylor, Birmingham—Window fastenings.
2210. W. Johnson, 47, Lincoln's-inn-fields—Steam-boilers.
2211. The Hon. W. E. Cochrane, 5, Osnaburgh-ter., Regent's park—Apparatus for converting crude iron while in a fluid state from a blast or other furnace into malleable or bar iron and steel.
2212. J. Maudslay, Lambeth—Fire-places for steam-boilers.
2213. T. W. Rammel, Trafalgar-sq.—Constructing railways and propelling carriages thereon.
2214. J. Roberts and J. Beech, Walsall—Railway chair.
2215. A. Ford, Chelsea—Dissolving vulcanized India-rubber for waterproofing, &c.
2216. G. W. Sayer, Mark-la.—Machinery for stopping railway carriages.
2217. T. E. Blackwell, Clifton, Bristol—Mode of constructing fire flues and air passages.

Dated 22nd September, 1856.

2218. W. Taylor, Woodhall-cottage, Shipborne, Tunbridge—Conversion of cast-iron into steel and malleable iron.
2219. R. Mushet, Coleford, Gloucester—Manufacture of iron and steel.
2220. R. Mushet, Coleford, Gloucester—Manufacture of iron and steel.
2221. W. B. Sellers and A. Sellers, Sheffield—"Ever-pointed" pencil cases.
2222. J. Wilson and C. Wootton, Birmingham—Improved screw wrench.
2223. J. Morrison, Birmingham—Improved penholder
2224. T. Wallace, Limehouse—Manufacture of wheels, axles, and axle boxes.

Dated 23rd September, 1856.

2225. J. G. Taylor, Glasgow—Fastenings and couplings.
2226. D. C. Boyd, 78, Welbeck-st.—Constructing flues for air or smoke.
2227. F. Wrigley, Long Island Iron Works, Carlisle—Friction coupling for the transmission of motive power.
2228. R. Winterbottom, jun., Lancashire—Making dry barm or yeast.
2229. R. Husband, Manchester—Silk hats.
2230. A. V. Newton, 66, Chancery-la.—Gimlets, augers, &c.
2231. W. Johnson, 47, Lincoln's-inn-fields—Machinery for doubling and twisting fibrous materials.

Dated 24th September, 1856.

2232. A. G. Baylis and J. Green, Redditch, Worcester—Needles.
2233. A. Barrie, Edinburgh—Instrument for registering the time at which workmen arrive at and leave their place of work.
2235. J. Cottrill, Studley, Warwick—Machinery to supersede hand labour for filing.
2236. A. V. Newton, 66, Chancery-la.—Carding engines.
2237. P. W. Barlow, Gt. George-st., Westminster—Permanent way of railways.
2239. W. Beatson, Rotherham—Puddling iron.
2240. C. Vion, 133, High Holborn—Metallic moulds for casting metals.
2241. V. F. A. Prost, Paris—Weaving, and machinery employed therein.

Dated 25th September, 1856.

2242. R. Brown, Glasgow—Taps or valves.
2243. T. Holmes and T. Aspinall, Pendleton—Preventing smoke.
2244. J. W. Wilson, Banbury—Machinery for manufacturing parts of brooms, &c.
2245. C. Sayno, Novara, Piedmont—Bearings, beds, or sockets for axles, &c.
2247. E. Sabatier, Paris—Permanent way of railways.
2248. H. W. Parnell, 13, Bryanston-sq.—Ships and boats.
2249. A. Albright, George-st., Edgbaston—Lucifer matches and boxes.
2250. R. Frost, Chester—Flour.
2251. J. J. Russell, Wednesbury, and J. B. Howell, Sheffield—Cast-steel tubes.
2252. M. A. Muir and W. J. Walker, Glasgow—Machinery for sizeing or dressing yarns, &c.
2253. S. Calley, Brixham, Devon—Compositions for coating bottoms of ships.

Dated 26th September, 1856.

2254. C. Langlois, Bath—Photography.
2255. J. F. Meakin, 84, Baker-st. Portman-sq.—Fire escape.
2256. M. Pellen, 68, Rue d'Anjou St. Honoré, Paris—Rendering impermeable by gas, caoutchouc, gold beaters' skin, paper, gauze, and similar materials used for things adapted to receive an ascending force, such as balloons, aerostatic machines, toys, &c., by the application of a peculiar varnish.
2257. C. Renshaw, Dukinfield, Cheshire—Squeezing rollers for pressing yarns, &c.
2258. W. Horsfall, Manchester—Carding fibrous substances.
2259. G. G. Woodward, Kidderminster—Carpets.
2260. F. Ransome, Ipswich—Artificial fuel.

Dated 27th September, 1856.

2262. D. Thom and G. A. Phillips, Manchester—"Soap frames."
2264. J. B. Ashbocking, Suffolk—Letter-press printing machines.
2266. W. Smith, Skinner-st., Snow-hill, and N. F. Taylor, Stratford, Essex—Apparatus for measuring gas.
2268. Captain J. M. Hayes, R.N., 6, Portland-ter., Southsea—Percussion cap holders.
2270. J. Rothwell, Park-hill, Bolton—Composition to promote the ignition and combustion of coke, coal, &c.

Dated 29th September, 1856.

2272. L. D. Jackson, Underwood, Selstone, Nottingham, and H. Myers, 52, Rathbone-pl.—Apparatus for the better working of breaks in stopping railway trains.
2274. C. J. Carr, Belper—Hammers and stamps.
2278. D. Thom and G. A. Phillips, Manchester—Apparatus used in the manufacture of soap.
2280. J. Lord, Rochdale—Improvements in the process of separating or recovering animal wool or silk from cotton and woollen, or from cotton and silk or other mixed fabrics, whereby the animal wool or silk is rendered capable of being again employed, which said improvements are also applicable to wool in its unmanufactured state.
2281. H. Jenkins, Birmingham—Buckles.—29th September, 1856.
2282. G. T. Bousfield, Sussex-pl., Loughborough-rd., Brixton—Artificial stone. (A communication.)

Dated 30th September, 1856.

2284. S. Ivers, Halshaw Moor, near Bolton-le-Moors—Looms for weaving.
2286. R. C. Ross, Glasgow—Paddle wheels.
2288. W. G. Gaul, Calstock, Cornwall—Bits for boring and sinking.

INVENTION WITH COMPLETE SPECIFICATION FILED.

2131. C. J. Dumèry, Paris—Improvements in apparatus for counting, registering, and indicating the distance travelled by vehicles, and the speed and time of travelling.—11th September, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

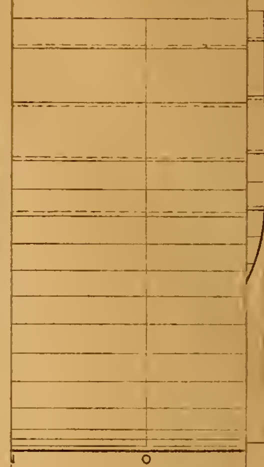
1856.

Sept. 13, 3873. J. J. Welch and J. S. Margetson, Cheapside, "Shirt."
,, 15, 3874. Wilcox and Co., Millwall Pottery, "Pedestal Urinal."
,, 15, 3875. T. Green, Coseley, near Bilston, "Camp Oven, or Pie or Bake Pan."
,, 17, 3876. Spilsbury and Downes, Huggin-la., Cheapside, "Fastening for articles of Dress."
,, 17, 3877. H. R. Freeborn, Manchester, "Improved Shirt."
,, 18, 3878. B. Benjamin, 74, Regent-st., "Oude Wrapper."
,, 20, 3879. H. L. Burton, 1, Goulden-ter., Islington, "A Carriage Frame, with Wheel, Breaks, and Guard, for suspending Cots and Carriage Bodies, for Infants, Adults, and Invalids."
,, 26, 3880. T. F. Hale, Bristol, "The Roller Action Pillar Pump."
,, 26, 3881. J. Gillott, Birmingham, "Metallic Pen."
,, 29, 3882. W. G. Speed, Shepton Mallet, "Separating Cheese Vat."
Oct. 6, 3883. H. J. and D. Nicoll, Regent-st., "Railway Rug or Carriage Wrapper."
,, 7, 3884. R. Leake and T. Dodd, 230, Oxford-st., "Paragon Bonnet Support."
,, 8, 3885. H. Craigie, Edinburgh, "Gas Apparatus for Heating Purposes."
,, 10, 3886. T. B. Bailey, Coventry, "Medal Fastener."
,, 10, 3887. T. Greaves, Birmingham, "A Fastener for securing Buttons to Boots, Vests, &c."
,, 10, 3888. H. Rawton, Leicester, "Apparatus to facilitate the Burning of Smoke in Furnaces."
,, 11, 3889. C. H. Proteri, Duke-st., Lincoln's-inn-fields, "Improved Railway Guard's Belt Chronometer Case and Message Box."
,, 14, 3890. R. Trimmins and Sons, Birmingham, "Machine for Paring, Slicing, and Coring."

AVIGATIO

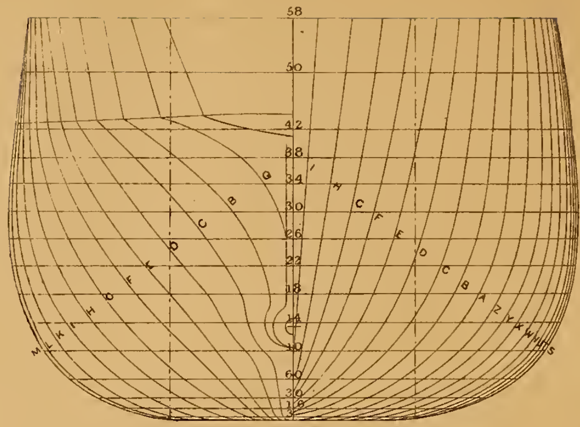
LINES OF TH

Fig. 1.



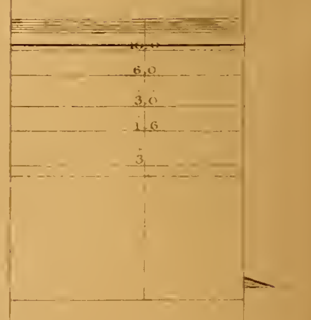
ELEVATI

Fig. 2.



AFT FORE

Fig. 3



HALF P

Wm. Smith C.E. direxit

THE ARTIZAN

EASTERN STEAM NAVIGATION COMPANY'S GREAT SHIP.

LINES OF THE HULL.

Fig. 2

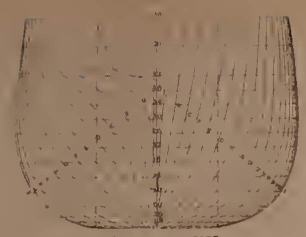
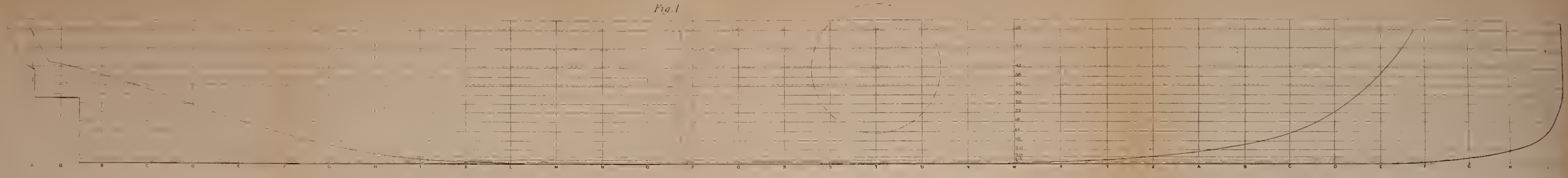
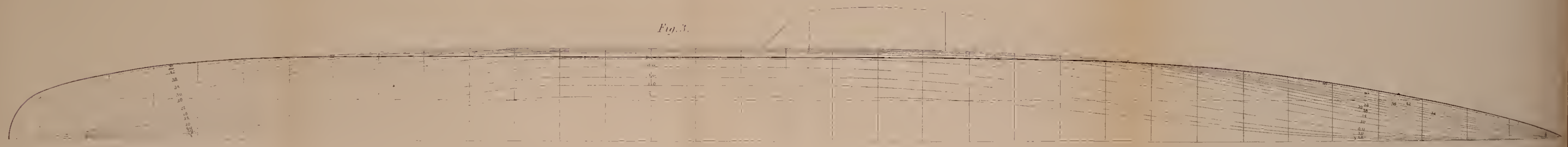


Fig. 1

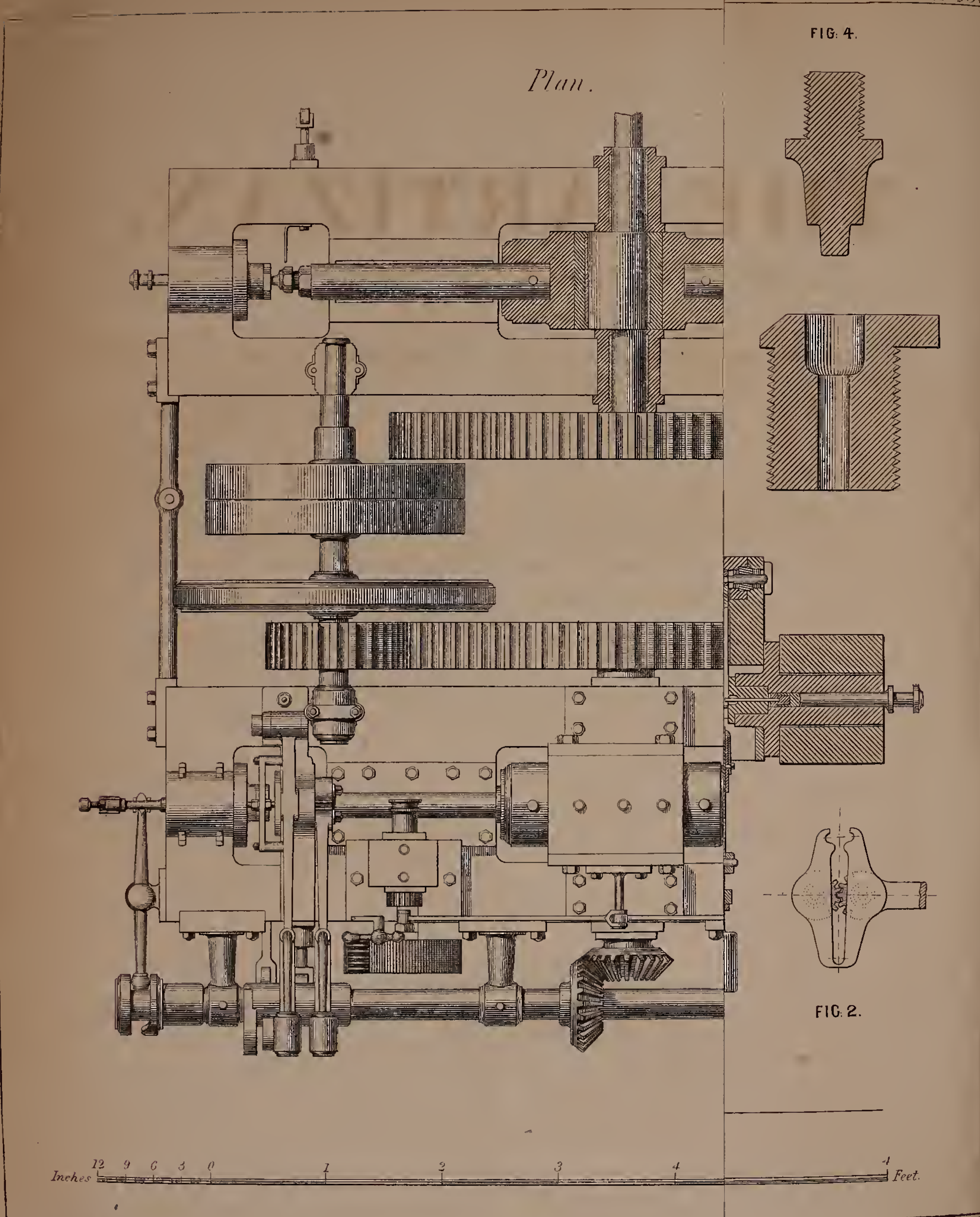


ELEVATION.

Fig. 3.



HALF PLAN.



W. Smith C.E. direxit. G.B. Smith sc.

THE ARTIZAN.

No. CLXVII.—Vol. XIV.—DECEMBER 1st, 1856.

THE GREAT EASTERN STEAM-SHIP.

We last month posted our readers up in the progress which had been made towards finishing the great ship up to the 25th October. Since that time great progress has been made in every department of the work.

The bows of the ship begin to assume the appearance of approaching completion. Mr. Brunel has wisely determined to double plate the entire length of the fore compartment with ¾ in. plates; they are nearly all in. The forged iron stem-piece, with its two large eyes, or hawse-holes, one above the other, is ready to be set up in its place, and thereupon the rest of the plating will be rivetted up; and the bows, it is expected, will be completed within the next month.

Generally, the plating of the ship is progressing rapidly, both skins being advanced together.

The deck plates are going on, and as much closing up as possible is being done against the approaching winter.

The disposition of the passenger accommodation, and the definitive arrangements as to offices and the internal fittings, are now under consideration.

One of the paddle-wheels is completed, the construction of the other is progressing; and the paddle-boxes are in the course of construction.

The last of the boilers for the paddle engines will shortly be in its place; the paddle engines are in course of erection on board.

The screw engines have not yet arrived from Soho. Nearly the whole of the pieces of the boilers for the screw engines are on the ground, and they are being put together with all speed. The screw shafts, which were forged at Mare and Co.'s Works, Blackwall, are also being turned at the Orchard Works; they are expected to be completed and ready for delivery within the next month.

The arrangements connected with the stern part of the ship are progressing rapidly. The rudder, and parts connected therewith, are determined upon, and will be at once commenced. The rudder is to be of two plate-iron cheeks, framed together on a wrought-iron rudder-post, tapering from 14 in. diameter downward; the frame will be 9 ft. wide from back to belly; but the side plates or cheeks will project beyond the rudder-frame to the extent of 3 ft., which will permit of experiments being tried, so as to determine the best dimensions of the rudder for steering. The space between the two plate-iron cheeks within the rudder frame will be filled in with wood.

The arrangements with respect to the cooking department—the position of the cattle, fowls, and other live stock on board, are matters now determined upon; and staircases have been introduced within the paddle-wheels, by which access can be had to the cooking department without interfering with the cabin arrangements.

On the whole, everything about the works betokens rapid progress, and we hope, in our next Number, to be able to state that many parts of the fittings, and of other matters now partially completed, are then entirely finished.

THE MACHINERY OF THE WAR DEPARTMENT.

THE CONICAL BULLET-MAKING MACHINERY.

(Illustrated by Plate lxxxviii.)

In our last month's Number we gave a short description of the ingenious bullet-making machinery, designed by Mr. Anderson, and described its peculiarities and the general details of the mode of working it. We illustrated the subject by a double Plate (Plate 89), exhibiting a side elevation and an end view of the four sets of machines arranged within one frame and driven by one set of overhead gear. We were unable to complete some of the details required for the Plate containing the plans and enlarged detached sectional view of the cutting, punching, and finishing movements, in time to give that Plate last month, and we substituted Plate 89 therefor; but with the present Number we give Plate 88, containing the plan and details necessary to make the subject perfectly understood.

In the accompanying Plate the principal figure is the plan view before referred to. The explanation given in our previous notice of this invention will, upon reference being made thereto, render any further description thereof unnecessary.

The other figures on the accompanying Plate are numbered 1, 2, 3 and 4.

Fig. 1 is part of an enlarged longitudinal section of machine, showing the eccentric which gives motion to the spindle, and to which the punch is attached; also exhibiting a section of the lever through which the lead-rod is pushed until it is seized by the nippers. There are likewise sections of the nippers, die, ejecting-spindle, and film-plate.

The bullet, after it is formed in the die, is pushed out by the ejector, and forced through the film-plate, which is then brought up in front of the fixed die (by means of a lever, which is acted upon by cams on the horizontal cam shaft), and which cuts off the superfluous frill or film which is formed around the bullet at the point of junction between the fixed and moveable dies, so that the bullet is then delivered ready for service into a box placed for the purpose of receiving them underneath the machine.

Fig. 2 is an enlarged view of the nippers for cutting off the blank or pellet of lead. The rod of lead, after passing through the feeding rolls on the machine, is seized by the upper part of the nippers, and is held there until it is separated from the rod: immediately after separation the nippers open at the top, and allow the pellet to drop down to the lower end, which then becomes closed, and there it is held until the punch pushes it partly into the fixed die; the nippers then open at the bottom, and, of course, close at the top, and receive another pellet, which in its turn drops and is taken forward by the punch into the fixed die; and so this continued opening and closing of the nippers, continues at every stroke of the machine.

The motion for opening and closing the nippers is obtained from a lever attached to the one half of the nippers, and which receives motion

THE CONICAL BULLET MAKING MACHINERY,

AT WOOLWICH ARSENAL,

BY JOHN ANDERSON ESQ^R

INSPECTOR OF MACHINERY TO H. M. WAR DEPARTMENT.

Plan.

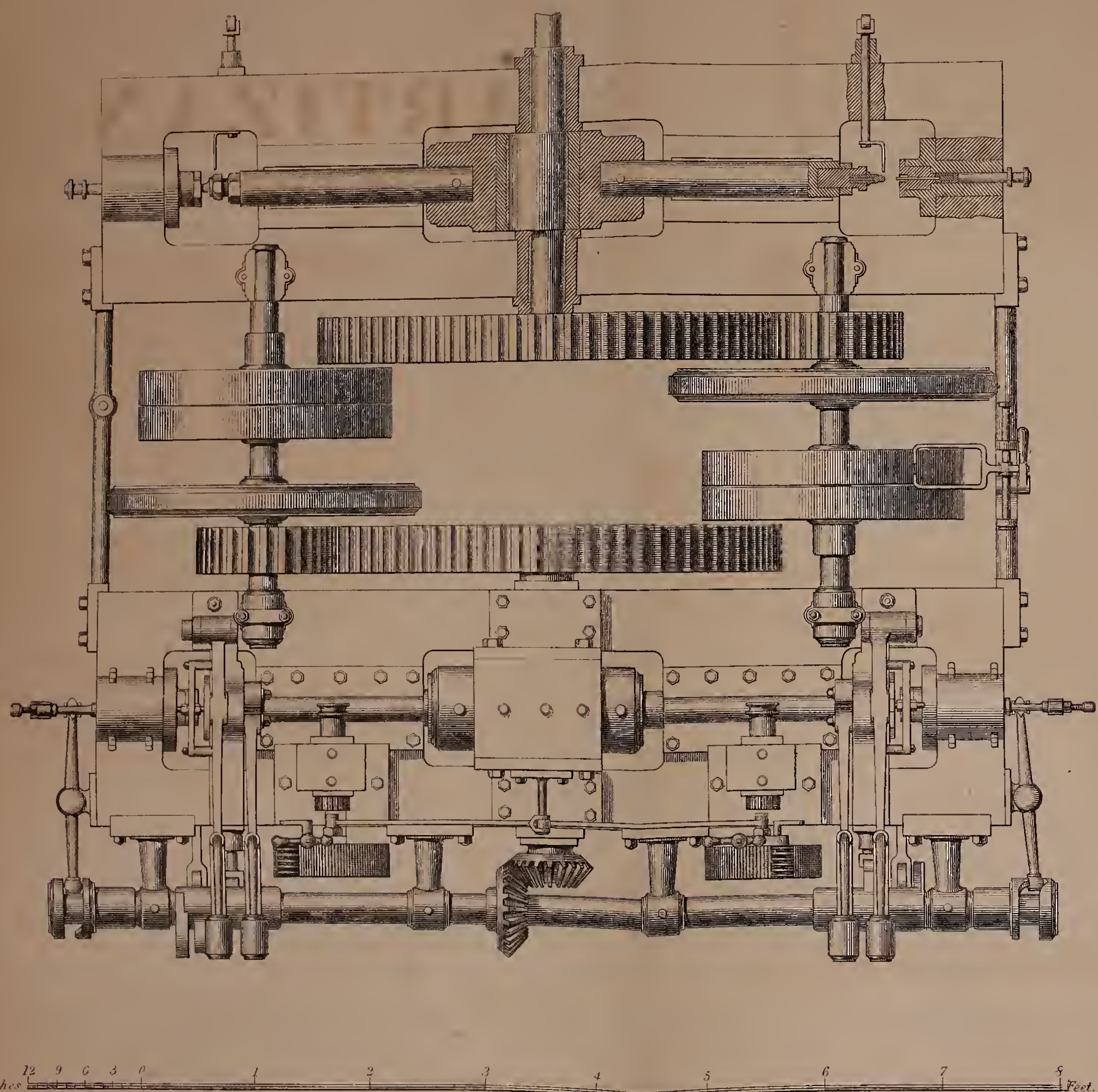


FIG. 3

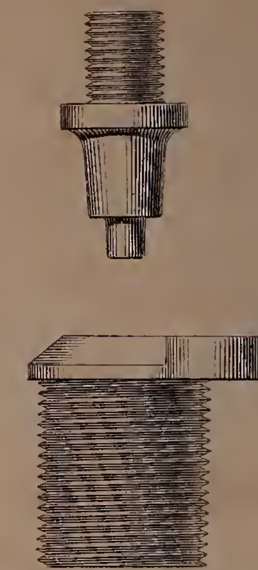


FIG. 4

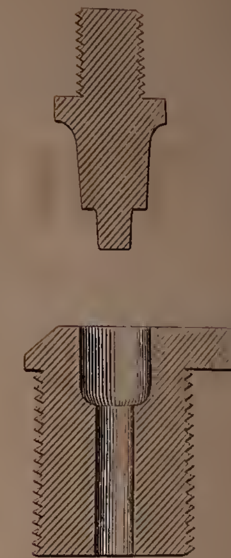


FIG: 1.

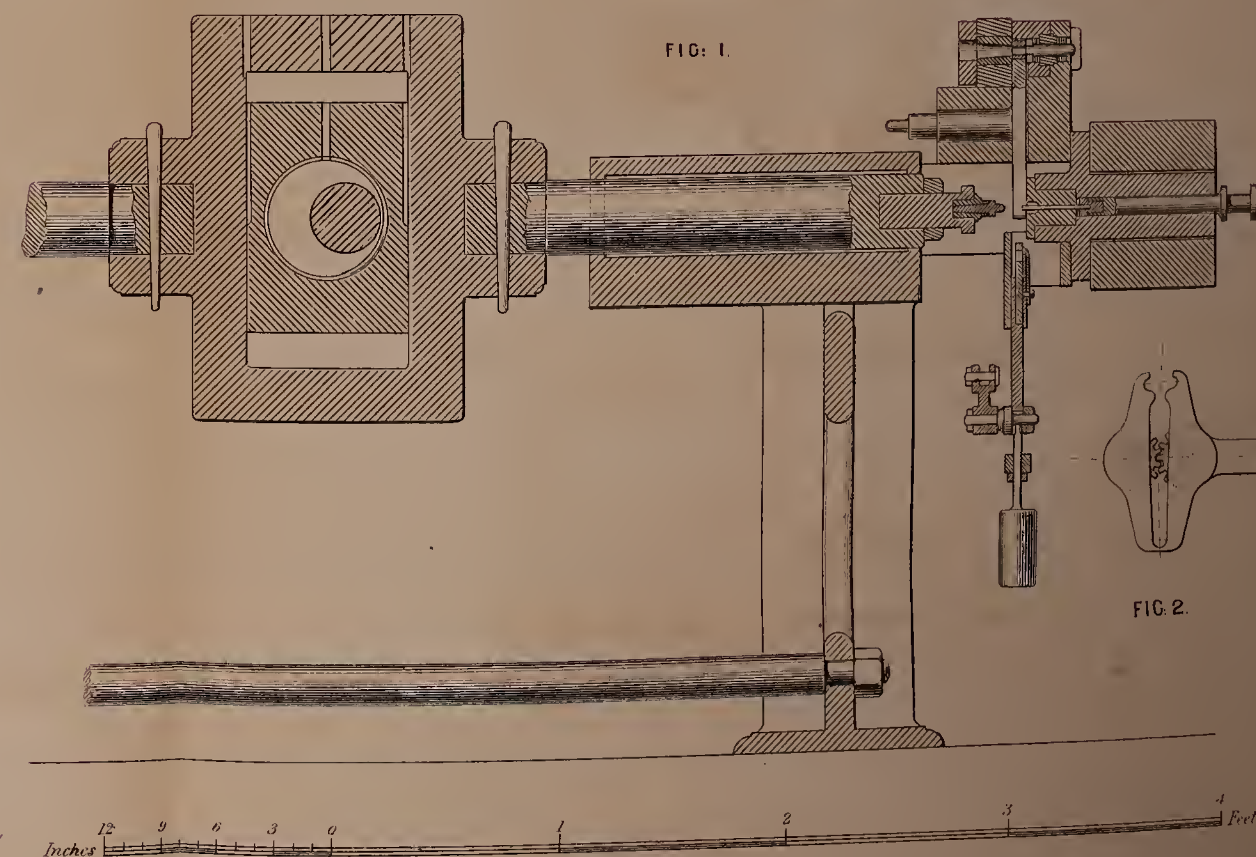


FIG. 2.

W. Smith C.E. direxit

G.B. Smith sc

from a cam on the cam-shaft on the end of this lever; a toothed segment is cut which gears into another toothed segment upon the other half of the nippers, so that by the alternate rising and falling of the lever, the continued opening and closing of the nippers is obtained.

Figs. 3 and 4 are enlarged views of the punch and die; the punch is screwed into the end of the reciprocating spindle, and is alternately carried backwards and forwards with it.

The die is a fixture in the framing of the machine, but made adjustable in all directions. The lead, after it is cut into the pellet, is taken from the lower part of the nippers by the punch, and is forced into the die, and so forms a complete bullet, the die forming the exterior portion, while the punch forms the hollow interior and end of the bullet. It will be seen that there is a large hole through the end of the die; in this the ejector works, the end of which is recessed out so as to form the end of the bullet complete.

The ejector has a small air-hole through it about the size of a hair; this is requisite to allow the air to escape, but from its being so very small, completely intercepts the escape of the lead.

In our next we purpose giving some accurate details with reference to the bullets produced by these machines—and then proceed to describe some of the other ingenious machines and contrivances recently introduced into Woolwich Arsenal.

THE "THUNDERBOLT" FLOATING BATTERY: PROGRESS OF STEAM NAVAL MATTERS AT WOOLWICH AND SHEERNESS.

Being present at an experiment with a new steam-whistle temporarily fitted on board of the *Thunderbolt*, and tried during her passage from Woolwich Dockyard to Chatham, on Monday the 24th of November, we had an opportunity of examining this floating battery, which was built by Messrs. Samuda and Co., and fitted with high-pressure horizontal screw engines of 100 H.P. by Miller, Ravenhill, and Salkeld. The boilers are of the description, and arranged as recently illustrated by us when describing the floating batteries.

The engines, although but just completed, worked admirably at 65 revolutions per minute, with steam at about 30 lbs. per square inch. The boilers gave plenty of steam, and when free from the muddy Thames water, and with 55 lbs. pressure, steam was well maintained, and no priming.

The *Thunderbolt* is of the largest class of floating battery; an excellent specimen of naval construction, and highly creditable to her builders.

Several improvements have been introduced into this vessel. Amongst the more prominent we noticed the domed wrought-iron deck houses, with horizontal loop holes, through which a concealed and perfectly protected rifleman can, at his ease, pick off the gunners of an opponent's ship.

The height between decks is greater; and with the improved system of ventilating and clearing the ship of smoke during action by an exhauster, such a vessel may be fought—which is more than we could say for the first of the floating batteries built in this country.

The shot-resisting iron gratings over the main and engine-room hatchways, are said to have been put to the test of a 64 pounder shot being allowed to fall from the mast-head, and they were found to stand the test thoroughly. Now we would suggest that they require a tye-bar along the tops and in the centre of the grating bars, as they are unsupported and unconfined except at their ends, and they are therefore liable to be sprung open. A notched bar of sufficient depth to take into the under sides of the grating bars would obviate this.

The temperature of the engine-room was cool and comfortable, notwithstanding the proximity of the numerous fiery mouths of the horizontal double-furnaced high-pressure boilers, as also the quantity of heat radiated from the cylinders; everything about the engines, *except the bearings* (thanks to the well arranged system of lubrication), being at the high temperature due to pressure of steam used.

We did not see any indicator diagram taken; and as it was not an *official* trial trip, the accurate and economic performance of the machinery cannot be here given; but we may hereafter make it our business to post our readers up in the actual performances of these and other of the high-pressure engines at work in the Royal Navy; and such information will be useful in pointing out some of the consequences of the system pursued during the war with respect to the construction and fitting of some of the engines and machinery made for the Government.

In the Steam-Basins at Woolwich, we observed the *Banshee* under repair, and also many of our old friends of the paddle-race, now gradually becoming extinct: there are also several gun-boats, despatch vessels, and other steam-propelled war ships which are in course of being fitted with machinery, or, having been recently so fitted, are being rigged and got ready for departure to the various naval stations, and, if need be, to the Black Sea, or elsewhere.

Engineering matters at Woolwich yard appear to go on most satisfactorily under the able direction of Mr. Atherton, the chief engineer—overhauling and repairing the machinery and boilers, however, being the principal employment.

At Sheerness Dockyard there is not much doing in engineering matters that is worthy of note, except with respect to the gun-boats. The boilers of these vessels have proved to be, practically speaking, failures, in consequence of the tubes leaking; not so much in consequence of the pressure at which they are worked as from the intense heat which is thrown direct on to the tube plate, and thus it is subjected to a blow-pipe-like action. Now, the numerous leakages, although bad enough for an engineer to contend against when in fresh water, are much more troublesome when the vessels are in salt water, as the water is quickly evaporated, and deposits the salt in the ends of the tubes, which checks the draught and affects the keeping up steam; for as the salt is deposited, it and the fine ashes become concreted together, the area of the tubes becomes reduced, and the draught is entirely destroyed. So hard does this mass become, that it has been known to take *two days* to clear out one tube.

With a view to remedy this grave defect, we understand that Mr. Lloyd has proposed the plan of a second, or dipping bridge, placed behind the present bridge, and before the tubes; but it is doubted if this will have the desired effect; indeed, it may be found to increase the blow-pipe-like action. But we shall keep our eye on the alteration.

There is another matter which we observed, and which should not be passed over by us. Our description of the engines, boilers, &c., of the Despatch gun-boats will be remembered by our readers; and one peculiarity belonging to them was their having two low fighting boilers, and two high running boilers. Experiment demonstrated at a very early date that in vessels of this class, having 360 H.P. on board, and from the small immersion of the screw, the speed gained by using the two running boilers, in addition to the fighting boilers, was only half a knot.

Notwithstanding that this was known long before the *Nimrod's* boilers were ready to be put into their places, the whole of the boilers were at great expense and trouble put into her, and the decks, &c., closed up; but no sooner was this done, than the authorities commenced tearing the vessel to pieces, for the purpose of removing the boilers, intending that the space should be used as coal bunkers.

By-the-by, it is to be regretted that the designer of these vessels did not make them much broader in the beam, like fishing smacks, so that they might have carried more sail, as at present they have only fore and aft sails; so that they are compelled to steam, which they do at great disadvantage, arising from the slip of the screw and the small quantity of coals they are enabled to carry, amounting, as it does, to only 30 tons.

At Sheerness yard the *Emerald* frigate is being fitted with engines of 600 H.P., by Miller, Ravenhill, and Salkeld; they are nearly completed, and will shortly be tried. We cannot too strongly point to what must prove a great disadvantage in connection with the fitting of these engines—viz., the crowding into a comparatively small engine-room space large engines. We say that a space of only 2 ft. at the back of the cylinders is too little to enable the cylinder covers to be taken off, or for those who have charge of the engines to get at their work comfortably. We are not advocating the sprawling out of the parts of engines, but we cannot too strongly insist upon sufficient space being afforded to allow of every part of the engines being at all times readily got at; and when there are internal wearing surfaces, or parts requiring re-packing or renewing, that provision should be made for the covers or parts being removed *with facility* by the engineer, under every variety of circumstance in which he may be placed whilst in charge of his engines and machinery.

Returning to the point at which we set out in the course of our present remarks, as to the trial of the new steam-whistle, we shall defer expressing any decided opinion until proper experiments be made with it, by which we can compare it correctly with the power of the best steam-whistles in use in the Navy; but we certainly never heard so powerful an instrument, or one capable of being readily varied and continued in volume and tone, as the invention of Mons. Lethuillier-Pinel, of Rouen, experimentally used on board the *Thunderbolt* floating battery.

WESTMINSTER BRIDGE.

In our article for last month upon Westminster Bridge we referred to the desirability of constructing a new bridge of a permanent character, at about 150 to 200 ft. below the old bridge. As regards the expense of a permanently-constructed bridge, some of our readers may have read an account of the fall of a bridge at Darlington, over the river Tees; and we find, from the printed evidence upon the cause of the failure—as the different engineers and others capable of judging of the matter so stated—the bridge fell from insecure foundations, and the want of sufficient packing at the haunches—of wanting solid string courses on the piers—they had better have had bad bricks and mortar than have been without: for it is pretty clear that the main cause of the failure was in endeavouring to construct the bridge at too small a cost; and, as Mr. Hodson, C.E., stated in his evidence, "it could not have been built better for the money," thus saying for the structure the best that could be said of it. This unfortunate failure, which was accompanied with the loss of two human lives, ought to be an example for not making a cheap bridge, even if other cases were not numerous of "saving a penny to throw away a pound."

We may mention the new bridge of "Alma," at Paris, which, although not a complete failure, has at least settled considerably more than was expected. The artistical design of the bridge is very good, and the only regret is, that the mode of construction of the foundation is not of that permanent order to insure its lasting—it being made of *bêton* or concrete.

In support of this kind of construction, it may be said that it is well known that many of the arches and vaults of the Roman buildings were made in a somewhat similar manner, and have lasted for ages; but, at the same time, be it remembered, the Roman bridges were not so constructed, nor was this mode adopted when settlement from insecure foundations was possible.

We remember hearing an account of a celebrated English engineer who constructed an elegant stone bridge across the Meuse at Val St. Lambert, being considered very extravagant for adopting the expensive mode of constructing the bridge with *piled* foundation instead of the cheaper system adopted in the new bridges at Liege—the Val St. Benoit and Bouverie—the result of which economy has been the settling of one or some of the piers of the former of these two structures to such an extent as to require one of the arches to be propped up; and, if we mistake not, the Bouverie bridge wholly fell down at first, and was obliged to be rebuilt; whereas the Val St. Lambert bridge has stood without requiring anything being done to it. Such examples, and many others which we might cite, will, we trust, induce the Chief Commissioner of Works, and a willing Parliament, not to be too economical in the fixing the sums to be devoted to the new bridges required across the river Thames.

Although we have confined ourselves, up to the present time, to the question of the necessity for constructing a new Westminster bridge, there are several others required before our bridge communication comes up to any similar proportion to the traffic of that of other large cities intersected by rivers—such as Paris, or even Dublin. Besides a bridge below the new Houses of Parliament one is required higher up, some little way above, or near to, the Horse-Ferry. There should also be one at Charing Cross. Indeed, it has been proposed to widen Hungerford suspension bridge, although, as a principle, we object to carriage suspension bridges: still, a suspension carriage bridge is better than not having sufficient communication. A new bridge at Blackfriars, and one opposite to St. Paul's Cathedral, are also required. Thus, to make the communication between the two sides of the river in any degree equal to the traffic, it would be advisable to have at least four new bridges, one widened, and two (Southwark and Waterloo) opened free of tolls. Until this is done, we shall always have crowded bridges and stoppage of communication between the north and the south sides of the Thames.

THE NEW BUILDINGS, &c., AT WOOLWICH ARSENAL.

THE late war has been productive of great alterations for the better in the arrangements of the Royal Arsenal at Woolwich. Buildings are being erected, and machinery supplied for them, on a magnificent but judicious scale.

A large building for casting hollow shot and shells is now nearly completed.

There is also in course of erection a large foundry for the purpose of casting guns of the largest calibre. The arrangement for lighting and cranage seems to us admirable. The light is taken from the roof at the north side, so that the sun's glare will not distract the workpeople; and there are several travelling cranes, of from 15 to 25 tons, on the most improved construction. In the same department a large boring mill, for boring and finishing the largest guns which may ever be found useful—is also being constructed, and is rapidly progressing towards completion. This machinery is to be driven by two 40-horse high and low pressure double cylinder engines, made by Messrs. Rennie and Sons.

The arrangements, so far as we are able to judge from a recent visit to the works, reflect the highest credit on the Inspector of Machinery to the War Department, Mr. John Anderson, as well as to the "Building Engineer," Mr. David Murray, for the tasteful architecture and general good arrangement of the buildings. We hope, when the works are further in progress, to give more detailed accounts of the extent of these additions to the resources of this country for producing war material and machinery, as well as some interesting particulars, which we have by us, of the several ingenious mechanical contrivances and new and powerful tools employed in the three departments of the Royal Arsenal.

Some of these machines are now in course of illustration by us; for instance, the bullet-making machinery, by Mr. Anderson, given in our last and in the present Number; and these will be followed by other illustrations of the new machinery and appliances employed in the War Department.

NOTES ON THE PROGRESS OF ENGINEERING, &c.

(FROM OUR OWN CORRESPONDENT.)

Southampton, November 24, 1856.

THE U.S. steam-frigate *Merrimac* sailed from here on the 29th ult., having had her defective foot-valves in air pumps replaced by new ones, with larger area through the gratings, the old valve-seats having 176 sq. in., and the new ones 230 sq. in. for each foot valve, as mentioned in our last Number.

We have been favoured by Mr. Long, the chief engineer, with the result obtained by this increase, viz.: in one engine 2 in., and in the other $1\frac{1}{2}$ in. more vacuum in the condensers.

By a friction diagram taken from these engines, with the screw disconnected (that is, *hoisted*), and the vessel at anchor, the H.P. absorbed in friction alone appears to equal 71 H.P.; but of course this amount would be greater when the whole pressure of steam is admitted to the engines for propelling the vessel: in other words, the friction of the machinery, when *loaded*, would of course exceed the friction when the diagrams were taken. The actual amount of the increased friction of the load cannot, of course, be measured by the indicator, and must be a constantly varying quantity; but Mr. McNaught estimates it at $\frac{1}{20}$ of the increased pressure upon the piston. The diagrams below are accurate copies of those obtained from the *Merrimac* under the before-mentioned circumstances. It will be observed that the revolutions, at

MERRIMAC, "C," H.P. = 70·7.
Friction Diagram, Forward Engine, Oct. 23, 1856.
Revolutions, 40. Average Pressure 2.39.

MERRIMAC, H.P. = 72·7.
Friction Diagram, After Engine, October 23, 1856.
Revolutions, 40. Average Pressure, 2.46.

the time the diagrams were taken, were only 40 per min., whereas the average revolutions at sea are about 45 per min.; but we think that the chief engineer exercised commendable caution in not allowing his engines to run too quick, as it is a delicate operation to try experiments on large engines when unloaded. We remember one instance in which the cylinder of a large paddle engine was split whilst running without the floats.

The Peninsular and Oriental Company's screw steam-ship *Simla* sailed, with the mails on board, on the 12th inst. for Sydney. She has been chartered for two years by the European and Australian Royal Mail Company, and will run in conjunction with the *Oneida* and *European* from Sydney to Suez. The *Simla* is a very fine vessel, and has performed admirably during her long engagement in the transport service: one of her runs, viz., from Plymouth to Malta Harbour, in 6 days 20 hours, a distance of 2,012 knots, has never been surpassed. She was built in Hull, and machinery by Messrs. Tod and McGregor, of Glasgow, in 1854; has geared engines, the multiple being 110 to 37.

Diameter of cylinders .... 90 in.
Stroke of pistons .... 6 ft. 6 in.

Each piston has four rods, with the ordinary steeple motion. Screw propeller has three blades; diameter, 17 ft. 6 in.; pitch, 23 ft., and uniform.

The boilers, four in number, are on Messrs. Lamb and Sumner's patent flue principle, and have produced very economical results, the consumption of coal at sea being only 3·8 lbs. per indicated H.P. per hour.

The *Simla* was tried at the measured mile in Stoke's Bay on the 7th inst., a great number of scientific and commercial gentlemen interested in steam navigation being present. She was very deeply laden, having on board all her coal, stores, &c., for the voyage to Australia.

Her draft forward was	21·6	20 ft. $10\frac{1}{2}$ in. mean draft.
„ aft „	20·3	

	Tons.	
Coal on board......	1.460	Total dead weight on board = 1,860 tons.
Water „	60	
Spare gear, &c. ...	40	
Stores and Cargo..	300	

Immersed midship section ....648 sq. ft.

Log on Measured Mile.

Mile.	Time. M. Sec.	Speed.	Revs.	Steam. lbs.	Vacuum. ins.
1st.........	4·42	12·766	$19\frac{1}{2}$	$15\frac{1}{2}$	26
2nd	5·25	11·077	19	15	26

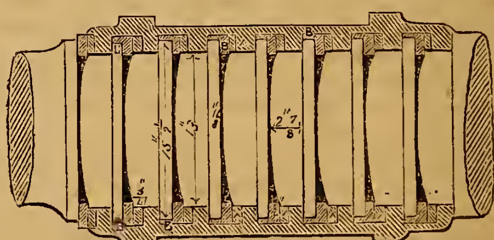
Mean speed .... = 11.921 knots per hour
Speed of Screw .... 13 „
Slip of ditto .... 1,1 „
Do. per cent .... = 9
Co-efficient of immersed midship section ....623 sq. ft.

This trial was made, as will be observed, under the disadvantages of great immersion, and from the draft forward exceeding that aft; but this will be remedied as she proceeds on her voyage, and her coals are consumed, chiefly from the fore part of the centre of gravity of the vessel, which will lighten her more quickly forward than aft. She was tried June 28, 1854, on her arrival from Scotland, at the same measured mile, her draft being 18 ft. forward, and 17 ft. aft; immersed midship section, = 517 sq. ft., when her mean speed was 13·35 knots per hour.

The *Oneida*, which sailed from here on the 19th ult. for Sydney, arrived at St. Vincent's on the 28th, after a fine run of nine days six hours; the distance is 2.350 knots.

H. M. S. *Himalaya* is still at Plymouth, uncommissioned. We understand that the Government engineers are so satisfied with the plan adopted by Gray, her late engineer, for the repair of her thrusting-block, that they have had the length of shafting which contains the thrusting-collars put into a lathe in the steam factory, and thoroughly carried out his plan by turning the collars down to a true surface, and pinning brass rings, in halves, on to their thrusting surfaces. By this means the new brass rings will thrust against the lignum vitæ segments, whereas, before this alteration, the rougheued iron collars formed the rubbing surface in contact with them. We mentioned, in a former Number, that the idea of fitting these lignum vitæ segments occurred to Mr. Gray in consequence of the rapid wear of the brass rings in the *Himalaya's* thrust-block; and we are pleased to be able to add that this simple method of quickly and cheaply renewing the thrusting surfaces of these blocks is likely to be adopted in other Government steamers, where the same difficulties have occurred. Mr. Gray has received the thanks of the commander of the *Himalaya*, Captain Priest, and also the expression of satisfaction from the Admiralty. We should like to hear of some more solid proof of their Lordships' appreciation of Mr. Gray's services.

PLAN OF THRUST COLLARS AND BEARING, *HIMALAYA*.
Scale, $1\frac{1}{2}$ in. = 1 ft.
A, A, A, are the lignum vitæ segments; B, B, the new brass rings.



By the subjoined sketch our readers will perceive that the thrusting surface in the *Himalaya's* thrust-block has been increased from 496 sq. in., as before the alteration, to 571 sq. in. We may add that it is a very important item to the success of wood bearings that their surfaces shall be thoroughly lubricated; in the present case this is effected by scoring the surface of the brass rings with *races*, which allows the water to circulate freely on all parts of the collars. We believe that water must be allowed to flow on all wood bearings of this nature, as the small quantity of oil which could be allowed for lubrication would not be sufficient to carry off the heat caused by friction.

The Belgian and New York screw steam-ship, *Leopold II.*, has just arrived here for the purpose of being docked for survey by Lloyd's Agents. She was built and fitted with machinery by the Cockerill Company, of Belgium, and is reputed to be a fast ship. She is about 1,800 tons burden, with inverted cylinder engines of 340 nominal H.P.

Diameter of cylinders.................................... 60 in.
Stroke of pistons .... 4 ft.
Revolutions per minute average 35.
Nominal H.P. at above revolutions .... 336.

Her engines have each two piston-rods, the air pumps being worked by beams from the cylinder cross-heads, and so assisting to balance the weight of piston and connecting-rods.

There is also a large balance-wheel keyed on to the crank shaft, which answers for turning engines by hand, and in some degree as a fly-wheel.

The screw is three-bladed, and projects beyond the after stern-post, as in Beattie's patent, the rudder being enclosed in the space between the two stern-posts, and the screw shaft dividing it in two pieces, which are connected by an oval looped rudder post. The screw is 18 ft. diameter, and 36 ft. pitch, so that with 35 revolutions of engines the speed of screw equals 12·4 knots per hour; and, as the diameter is so very large (for the power transmitted through it) there is, of course, but little slip.

The tubular boilers have twelve furnaces 3·8 wide, and 7 ft. long, thus giving 308 sq. ft. of grate surface; the tubes, 920 in number, are 7 ft. long, and 3¼ outside diameter. We hope to give some particulars of this vessel in our next.

The *Belgique*, belonging to the same Company, which sailed from here for New York last month, arrived at that port after a run of nineteen days, having met with very strong head winds the whole way across.

INSTITUTION OF CIVIL ENGINEERS.

November 18, 1856.

DISCUSSION ON MR. D. K. CLARK'S PAPER ON THE IMPROVEMENT OF RAILWAY LOCOMOTIVE STOCK.

After the reading of the paper "On the Improvement of Railway Locomotive Stock,"* by Mr. D. K. Clark, Assoc. Inst. C.E., which had been previously printed and circulated, a communication was brought forward, claiming for Mr. James Kennedy, of Liverpool, the merit of having first introduced a locomotive with horizontal cylinders and a cranked axle, inasmuch as it was asserted that they were first applied by Mr. Kennedy in the *Liverpool*, which was stated to have been started on the 22nd July, 1830, and was employed in aiding in the construction of the Liverpool and Manchester Railway. That engine was said to have frequently run, with a load, at the rate of 58 miles per hour. The wheels were 6 ft. in diameter, and there was a dome for a steam chamber. The principle of the *Liverpool* was stated to have been followed in the *Planet*, which had four wheels, and inside cylinders, as first adopted by Messrs. Stephenson, and also in the *Globe*, built for the Stockton and Darlington Railway by Mr. Hackworth.

It was explained, that the boiler of the *Liverpool* had a number of convoluted flues; that the fire was urged by bellows, without the aid of the blast pipe; that the engineer managed the engine at one end, and the stoker fired at the other extremity; that the speed attained never reached anything like 58 miles per hour; and that, as it had been built on speculation, after it had been tried on the Liverpool and Manchester Railway, with but indifferent success, the directors declined to become purchasers. It was then tried upon the Bolton line, and, after the substitution of a new multitubular boiler, with the blast pipe, and undergoing a thorough renovation, it was ultimately purchased by Mr. Hargreaves for the Bolton line. It was never considered the type for the class of engines used on the Liverpool and Manchester line. The horizontal cylinders and cranked axles had been commonly employed long previously, in Trevithick's, Gurney's, and almost all the other locomotives for turnpike roads; and the statements alleged to have been made by the late Mr. George Stephenson, as to the priority of the peculiar arrangement of the *Liverpool*, were asserted to be erroneous. It was well known that the *Planet*, which was admitted to have been the type of the engines employed on the line, was designed by Mr. Robert Stephenson; and the working drawings had been made and the engine constructed under his direction, without any reference to, or knowledge of the *Liverpool*. These facts were fully confirmed by those who were confidentially employed upon the engine at Messrs. Stephenson's works at the time. There was not any analogy between the two machines, as the *Planet* had a multitubular boiler, the fire being urged by a blast pipe, and the cylinders, which were as nearly horizontal as their position would permit, were fixed inside, or between the frames, because it was only by such an arrangement that they could be placed within the smoke-box, where it was considered desirable to fix them, in order to prevent the condensation of the steam in the cylinders, and the consequent loss of power. This determination had arisen from information given to Mr. R. Stephenson by the late Mr. Trevithick, who, in the course of some experiments upon the engine at the Dolcoath mine, had built a brick flue around the cylinder, and had applied the heat of a fire directly to the metal, with very beneficial results, as regarded the economical use of steam. With the cylinders in the smoke-box, a cranked axle was indispensable, and there was not anything new in its use in locomotives, for the *Novelty* had one in 1829.

It further appeared, from the delivery journal kept at Messrs. Stephenson's manufactory at Newcastle, that the *Planet* was charged to the Liverpool and Manchester Railway Company on the 3rd of September, 1830; that the minute book of the Board of Directors of that line, contained a record of the arrival of the *Planet* being reported to the board, at their meeting on the 4th of October, 1830; and that three weeks afterwards, at their meeting on the 25th of October, the *Liverpool* was reported to the board to be ready for trial.

Since the paper was written, the process of equilibrating the engines had been extensively applied on the South-Western Railway, producing an economy of fuel of nearly 11 per cent. Two passenger engines on the Cork and Bandon Railway had been equilibrated with the like benefit. On the same class of trains, the consumption of fuel before and after equilibration, was stated to be at the rates of 26 lbs. and 22 lbs. per mile, with trains consisting respectively of eight and ten carriages; showing a saving of at least 15 per cent. of fuel. It appeared from recent statements, that in America an economy of nearly 25 per cent. was obtained by heating the feed-water. Returns from twenty-two superintendents of locomotives on British railways showed, that in June, 1856, the cost of railway coke was 18s. 2d. per ton, whilst that, of coal used in locomotives was only 8s. 7d. per ton; and if, as had been stated, the effect produced was weight for weight the same, the economy would be upwards of 50 per cent.

A comparison of the results of the performances of five engines burning coke, and five burning coal, on the main line of the London and South-Western Railway, between London and Southampton and back, showed an average consumption of coke per mile of 20·7 lbs. with 10·4 carriages per train, against a consumption of coals of 18·9 lbs. per mile with 12·2 carriages per train. From this it would be seen, that there was a saving of 8½ per cent. in consumption of fuel in favour of coal, whilst the number of carriages per train was 14⅗ per cent. greater. The average cost of coke was 27s. 6d. per ton, and of coal 18s. 6d. per ton, giving a cost per mile of 3·04d. per mile in the former case, and of 1·87d. per mile in the latter, or a saving of 1·17d. per mile with trains 14⅗ per cent. heavier; but, notwithstanding this, the saving of fuel amounted to 38 per cent., and if the loads had been equal, then the saving would have amounted to 46½ per cent.

It was stated that, on the Shrewsbury and Hereford Railway, the results of burning all coal in the passenger engines—in place of half coal and half coke—taking the price of coke at 20 shillings, and of coal at 11 shillings per ton, was a saving of 0·69 of a penny per mile. These engines, when burning only coke, could never be got below 18½ lbs. per mile, whereas now they only burn 18·9 lbs. of coal, with the same average load, and running at the same speeds. With the four-wheeled coupled goods engine there was a saving of 2·05d. per mile in the cost of fuel by burning all coal, instead of one-third coal and two-thirds coke, with an average load of 168 tons in both cases. With the six-wheeled coupled goods engines, under similar conditions, the saving was 2·69d. per mile, with an average load of 188 tons. There was no difficulty in getting up steam, and there was a complete absence of all nuisance from smoke, which hitherto had been the chief difficulty to be overcome in the use of coal in locomotives. It was explained that the fire-bars, which were very thin, so as to allow of the free passage of air, were placed in a rocking frame, by which the level could be varied, according as the condition of the fire and the work to be performed demanded.

On the Northern of France line scarcely any other fuel than coal was now burned, and the economy resulting was fully one-third in money value. It should be stated, however, that the coal used was the dry semi-bituminous coal of the Mons Collieries, which was of excellent quality, whereas the coke was not good. The saving of 15 per cent. arising from the heating of the feed-water was admitted. It would, however, have been more conclusive to have tried coal and coke alternately in the same engine. The apparatus used in France was very simple, being merely a horizontal arrangement of the fire-bars, which were placed transversely, and in steps across the fire-box, so as to have wide air spaces, without risk of losing the fuel through the spaces.

In answer to questions, it was stated that the boilers of the South Western coal-burning engines were only a very little more expensive than ordinary boilers, and there did not at present, after very heavy running, appear to be any evidence of more rapid destruction of tubes, or of fire-boxes, than when burning coke; indeed, there was reason to apprehend that the particles of coal in combustion would do less mechanical injury to the tubes than the bits of hard coke rapidly travelling through.

Thin and careful firing was recommended, and with that there was no reason why the same results should not be obtained in the locomotive boiler with coal, as in a stationary boiler, under which coke would never be considered necessary.

It was generally admitted, that there was an entire absence of smoke in the engines of the South Western line, which was not the case on several other lines where the system had been tried—yet, bituminous

* See p. 157 of present volume.

coking coal had been tried, with the same good results. It was evident, then, that the fire tiles had considerable influence in producing that effect, as well as in enabling the engines to run home light, with scarcely any expenditure of fuel; the heat previously absorbed by the fire tiles being given out again when required, and thus keeping up the steam. Reference was made to a discussion at the Institution in 1839, where it was stated that, "to say that the 15 cwt. of coke, produced from a ton of coal, was equal in heating powers to the original ton, was to say that there were no heating powers to be derived from the 9 or 10,000 cubic ft. of gas produced, or the 10 gallons of tar." Now, it was possible that, in the arrangement of his boiler, Mr. Beattie had just arrived at the rate of combustion, and mode of employing the fuel, to take the utmost advantage of the whole of the carbonaceous matter, and all the inflammable gases contained in the fuel. If this were true, the progress was one of the most remarkable steps towards perfecting the locomotive engine.

In summing up the discussion it was observed, that although the subject had been treated with great ability by Mr. Clark, and the documentary evidence brought forward during the discussion was very conclusive in favour of the system, which indeed appeared to be generally admitted as a great and economical improvement, yet there still remained much to be done, practically, and to be described to the Institution. There were still several important discrepancies to be cleared up; and at this moment, when, for example, in India, it would be most important to burn only coal, as indeed had been done on the East India Railway for some time, the best methods were most desirable to be attained, and the descriptions should emanate from the Institution. The equilibrating of engines had been extensively and beneficially practised by Mr. J. V. Gooch on the Eastern Counties line, and on the system there was much to be learned and to be communicated to the Institution.

INSTITUTION OF CIVIL ENGINEERS.

The Council of the Institution of Civil Engineers have awarded the following Premiums for Papers read during the Session 1855—56.

1. A Telford Medal, and a Council Premium of Books, suitably bound and inscribed to John Murray, M. Inst. C. E., for his paper "On the Progressive Construction of the Sunderland Docks."
2. A Telford Medal, to John Mortimer Heppel, M. Inst. C. E., for his paper "On the relative proportions of the top, bottom, and middle webs of Iron Girders and Tubes."
3. A Telford Medal, to Henry Robinson, Assoc. Inst. C. E., for his paper "On the Past and Present Condition of the River Thames."
4. A Telford Medal, to Charles Robert Drysdale, Assoc. Inst. C. E., for his paper "On Steep Gradients of Railways, and the Locomotives employed."
5. A Telford Medal, to Frederick M. Kelley (New York, U.S. America) for his paper "On the Junction of the Atlantic and Pacific Oceans, and the practicability of a Ship Canal, without Locks, by the Valley of the Atrato.
6. A Council Premium of Books, suitably bound and inscribed, to George Herbert, for his paper "On the Construction of Buoys, Beacons, and other Stationary Floating Bodies."
7. A Council Premium of Books, suitably bound and inscribed, to Evan Hopkins, for his paper "On the Vertical Structure of Primary Rocks, and the general character of their Gold-bearing Varieties."
8. A Council Premium of Books, suitably bound and inscribed, to William Heink, for his paper "On Improvements in Diving Dresses and other Apparatus for Working under Water."
9. A Council Premium of Books, suitably bound and inscribed, to John Baillie (Vienna), for his paper "On the Application of Volute Springs to the Safety-valves of locomotive and other boilers."
10. A Council Premium of Books, suitably bound and inscribed, to William Kemble Hall (U.S. America), for his paper "On the Causes of the Explosions of Steam Boilers."

SUBJECTS FOR PREMIUMS,

SESSION 1856-57.

The Council invite communications on the following, as well as other subjects for Premiums:—

1. On the Principles upon which the Works for the Improvement of River Navigation should be conducted, and the effects of the works upon the Drainage and Irrigation of the District; including accounts of the Systems of Moveable Dams ('Barrages Mobiles') in Rivers on the Continent.
2. The Inundations of the Rhone and the Saone in the year 1856, the causes to which they may be attributed, and the means for averting their recurrence.
3. On Reclaiming Land from Seas and Estuaries.
4. The main Natural and Artificial Drains of the Country, the extent to which they have been affected by the increasing amount of Agricultural Land Drainage, and the general influence upon the main river outfalls.
5. The selection of Sites for the Construction of Docks on the course of Tidal Streams, with reference to communication with Railways, and with Inland Navigation.
6. The application of Wrought Iron to the Construction of Dock Gates and Caissons.
7. The selection of Sites for, and the principles of, the construction of Breakwaters and of Harbours of Refuge; and of Piers, Moles (whether solid, or on arches), Seawalls, and Shore Defences; illustrated by examples of known constructions.
8. The history and practical results of Timber and Iron Piling, for Foundations, or other purposes, and for Wharf and Dock walls; with notices of mechanical modes of driving, and of other modes of inserting the piles.
9. Accounts of the failure of Large Structures consisting of one, or more Arches, with the presumed, or ascertained causes.
10. The laws of the Strength of Cast and Wrought Iron, under the various conditions of Tensile, Compressive, Transverse, Tortional, Impulsive, and other Strains; with examples illustrative of the co-efficients employed by eminent practical authorities, in the construction of works.
11. The forms and dimensions of Journals of Machine-shafts, Axles, &c.; with the best Composition for the linings of bearings, and the most approved methods of lubricating.
12. The construction and use of Wrought Iron Girders and Joists, with arches, iron plates, concrete, or other incombustible substances, for buildings.
13. The construction of Suspension Bridges with Rigid Platforms; their adaptation to Railways, and the modes of anchoring the Stay Chains.
14. The comparative advantages of Iron and Wood, or of both materials combined, for the construction of Steam Vessels, with drawings and descriptions;—the methods for preventing Corrosion;—and details of the arrangements for the Compasses, and for their adjustment in Iron Ships.
15. The substitution of Machinery for manual labour, for Raising, Lowering, and Reefing the Sails, Weighing the Anchor, &c., on board ship.
16. An examination of the circumstances which appear to limit the maintenance of higher speeds, than are now attained by Steam Ships in deep-sea navigation; and an inquiry into the causes which have hitherto prevented the asserted high speeds of Steam Navigation, on the American Rivers, from being arrived at in England.
17. The results of the use of Tubular Boilers, and of Steam at an increased pressure, for Marine and other Engines, noticing particularly the difference in weight and speed, in proportion to the Horse Power, and the Tonnage; with details of the most successful means for avoiding Smoke in Furnaces of all descriptions.
18. The best methods of reducing the temperature of the Engine and Boiler room of Steam Vessels, and of preventing the danger arising from the over-heating of the base of the funnel.
19. The relative efficiency of the Screw Propeller and Paddle Wheels, when applied to vessels of identical form, tonnage, and Steam Power, independent of the use of sails.
20. The arrangement and distribution of the Workshops at the principal repairing station of a railway, for the repairs and maintenance of the Locomotives, Passenger, and other Carriages, &c.; derived from existing examples.
21. The comparative merits of the various systems of Locomotive Engines; having reference to the speed, the load conveyed, the economy of working, and the fuel employed, whether Coke, Bituminous Coal, or Anthracite.
22. The use of Steam expansively in Locomotive Engines, and the different systems of gearing employed.
23. The principles of construction, the framing, the boiler, the distribution of weight, and the conditions of stability of Locomotive Engines.
24. Improvements in the Manufacture of Iron for Rails and wheel Tyres, having special reference to the increased capability of resisting lamination and abrasion; and accounts of the machinery required for rolling heavy Rails, Shafts, and Bars of Iron of large sectional area.
25. On the Cost of Maintenance of the Permanent Way; noticing the principal systems in use, whether with Wood or Iron Sleepers, and the depreciation of the Rolling Stock of Railways.
26. Improvements in the construction of Railway Carriages and Waggons, with a view to the reduction of the gross weight of Passenger Trains; also of Railway Wheels, Axles, Bearings, Axle-Boxes, and Breaks; treating particularly their ascertained duration and their relative friction.
27. The forms of bearing, traction, and buffer Springs of Railway Carriages and Waggons.
28. Description of the peculiarities of construction, and the cost of the Lines of Railway in India,—in Egypt,—in Australia,—in Canada,—and across the Isthmus of Panama.
29. On Public Works in India.
30. The results of a series of observations on the flow of Water from the Ground, in any large districts; with accurately-recorded Rain-Gauge Registries, in the same locality, for a period of not less than twelve months.
31. On the construction of Catch-water Reservoirs in Mountain Districts, for the supply of Towns, or for Manufacturing purposes.
32. Accounts of existing Water-works; showing the methods of supply, the distribution throughout the streets of Towns, and the general practical results.
33. The comparative duty performed by the various descriptions of Steam-engines for raising Water, for the supply of Towns, or for the Drainage of Mines; noticing, in the latter cases, the depth and length of the underground workings, the height of the surface above the sea, the geological formation, the contiguity of streams, &c.
34. The results of the use of Bucket and Rotary Pumps, for lifting large quantities of water to a limited height; as at the Haarlem Mere, or at Whittlesea Mere: with descriptions of the Machinery employed.
35. The Drainage and Sewerage of large Towns; exemplified by accounts of the systems at present pursued, with regard to the level and position of the outfall, the form, dimensions, and material of the Sewers, the prevention of emanations from them, the arrangements for connecting the house drains with the public sewers, the disposal of the sewage, whether in a liquid form, as irrigation, or in a solid form after deodorisation.
36. The precautions adopted for guarding against Accidents by Fire-damp in Mines.
37. Mechanical Methods of Boring and of sinking large shafts, of introducing the Tubbing and impervious lining, and of traversing running sand, and other difficult strata.

38. The results of contrivances for facilitating the driving of Tunnels, or Drifts in Rock.
39. Descriptions of the various kinds of Machinery in use in the principal Shipping Ports, for the shipment of coal; noticing particularly those in which the greatest expedition is combined with the least amount of breakage of the coal; and also accounts of the means of unshipping and measuring, or weighing the coal, on its arrival in port.
40. Descriptions of the Ovens, and of the best processes used in Great Britain and on the Continent, in the manufacture of Coke for Railway and other purposes; with the comparative values of the products.
41. Improvements in the system of Lighting by Gas; the results of the use of Clay Retorts,—of large Ovens (for producing a better quality of Coke)—of Exhaustors, Condensers, and modes of Purifying, and the precautions for the economical distribution of Gas.
42. The most effective arrangement and form of Centrifugal and Reciprocating Blowing Apparatus.
43. The Chemical Analysis, and the application to economic purposes, of the Gases generated in Iron Blast Furnaces.
44. Descriptions of modifications of the present systems of Smelting Iron Ores, of improvements in the conversion of cast iron into the malleable state, and of the manufacture of iron generally, comprising the distribution and management of Iron Works.
45. An investigation of the causes of "Red" and of "Cold-Shortness" in Malleable Iron, and other Chemical Characteristics which affect the Physical Properties of Cast, or of Wrought Iron.
46. An investigation of the changes stated to be produced in large masses of Wrought Iron, by repeated heating and hammering.
47. The production of large masses of Cast Steel, with a description of the improved processes for converting Cast Iron into Cast Steel, and the modes of treatment to insure soundness.
48. Improvements in the methods of Shearing and Punching Sheet-iron, and Boiler-plates.
49. The process of manufacture, and mode of treatment of Aluminium.
50. Mechanical Improvements in Ordnance and Projectiles.
51. Description of Cast or Wrought Iron Cranes, Scaffolding and Machinery, employed in large works, in Stone Quarries, Hoists, or Lifts on Quays, in Warehouses, &c., especially where either Steam or Water is used as a motive power.
52. Improved processes and Machinery for sawing, working, and carving Timber or Stone.
53. On the Improvements which may be effected in the Buildings, Machinery, and Apparatus for producing Sugar from the Cane, in the Plantations and Sugar-works of the British Colonies, and the comparison with Beet-root, with regard to quantity, quality, and economy of manufacture.
54. Accounts of the improved systems of storing, cleansing, and drying Corn, and of producing Flour.
55. Description of the Machinery adapted for the preparation of Indian cotton.
56. Improvements in Flax Machinery, and in the processes for preparing the Flax for manipulation.
57. The uses of Vulcanized Caoutchouc in Machines; the means of increasing its durability, and the modes of causing its adhesion to metal.
58. Notice of the principal Self-acting Tools employed in the manufacture of Engines and Machines; and the effect of their introduction.
59. The construction of Lighthouses; their Machinery and Lighting Apparatus; with notices of the methods in use for distinguishing the different Lights.
60. The construction of Clocks to be moved simultaneously by the agency of Galvanic Electricity.
61. The History of the Submarine Telegraph; with accounts of the mode of forming the cable, the system of laying it down, and of working it over great lengths.
62. Memoirs and accounts of the Works and Inventions of any of the following Engineers:—Sir Hugh Middleton, Arthur Woolf, Jonathan Hornblower, Richard Trevithick, William Murdoch (of Soho), Alexander Nimmo, and John Rennie.

Original Papers, Reports, or Designs of these, or other eminent individuals, are particularly valuable for the Library of the Institution.

The communications must be forwarded on or before the 30th of January, 1857, to the house of the Institution, No. 25, Great George Street, Westminster, where copies of this Paper, and any further information, may be obtained.

CHARLES MANBY, *Secretary.*

AGRICULTURAL ENGINEERING.

AT a recent meeting of the Institution of Mechanical Engineers, at Birmingham, a Paper was read by Mr. W. Waller, of Lincoln, on "The Application of Steam Power to Agricultural Purposes," and which Paper entered very fully into the various peculiarities of the Engines constructed for Agricultural purposes by several of the best known makers, and it compared their relative merits.

We do not intend at present entering upon that part of the subject; but we think it will prove useful to our readers to give the following account of the trials of various Engines described in Mr. Waller's Paper:

The manner in which the engines are tested by the judges of the Royal Agricultural Society is as follows:—

The various engines are entered, declared at a certain power at which only they are to be tested; thus, suppose an engine having a 5 ft. fly-wheel pulley entered as an 8 horse power engine, running at 120 revolutions per minute. Eight stone of coal, of 14 lbs. to the stone, with a certain quantity of wood to light the fire, are given to the engineman, who has previously had the engine at work, and run the steam down to 20 lbs. or 25 lbs. per square inch pressure, as the case may be, and emptied and swept out the firebox. The fire is then relighted, and the steam is got up to 48 lbs. per square inch, at which pressure the engine must start. The dynamometer is supposed to have a 3 ft. 6 in. belt pulley, and a 4 ft. 6 in. wheel with a friction break on it; then the centre of the pin or pointer to which the scale is attached being 2 ft. $7\frac{1}{2}$ in. from the centre, equivalent to a circumference of 16·5 ft., it will require a weight of 93·33 lbs. suspended from the pin to give the desired 8 horse power, according to the following expression:—

$$\frac{93{\cdot}33\text{ lbs.} \times 16{\cdot}5\text{ ft. circumf.} \times 5\text{ ft. pulley on engine} \times 120\text{ revs. per min.}}{3{\cdot}5\text{ ft. pulley on dynamometer}} = 264{,}000\text{ lbs.}$$

raised 1 ft. high per minute.

$$\text{And } \frac{264{,}000}{33{,}000} = 8\text{ H.P.} = \text{the H.P. of the work done.}$$

The engine being started with a belt connecting the flywheel to the belt pulley, a man is placed at the adjusting screw of the dynamometer to slacken or tighten the friction blocks, so as to keep the weight exactly in balance with the friction, and the pointer in a line with the centre of the shaft, during the whole time of working the engine. The number of revolutions of the break wheel is registered on a counter by means of an eccentric on the shaft of the dynamometer. It is the business of the engineman to get the greatest possible number of revolutions out of the engine; then the total number of revolutions of the break wheel divided by $\frac{5 \times 120}{3{\cdot}5}$ gives the number of *minutes of duty* the engine has done, that is, the number of minutes of time the engine would have taken, if it had made *exactly* 120 revolutions per minute during the entire time of running, $\frac{5 \times 120}{3{\cdot}5}$ being the number of revolutions per minute of the break wheel, corresponding to 120 revolutions per minute of the engine. The minutes of duty converted into hours and decimals, and divided into the 14 lbs. of coal supplied per horse power, give the duty performed in the quantity of coal consumed per horse power per hour. Thus at the Carlisle Exhibition, Messrs. Tuxford's engine did duty 3 hrs. $47\frac{1}{2}$ mins., or 3·8 hrs.; this with 14 lbs. of coal per horse power gives 3·7 lbs. of coal per horse power per hour.

The following Table I. gives the weight in pounds, to be placed in the scale of the dynamometer for each horse power from 4 to 10 horse power, at intervals of 10 revolutions from 110 to 150 revolutions per minute of the engine. The Table is calculated by the following formula:—

$$w = \frac{\text{H.P.} \times 33000 \times d}{c \times \text{D} \times n}$$

where w = the weight in lbs. to be placed in the scale of the dynamometer, H.P. = the horse power of the engine, d = the diameter in feet of the pulley on the dynamometer, c = the circumference in feet corresponding to the distance of the pointer carrying the weight from the centre of the break wheel, D = the diameter in feet of the driving pulley of the engine, and n = the number of revolutions of the engine per minute.

TABLE I.

Weights for Dynamometer.

Revolutions of engine per minute.	4 Horse Power.	5 Horse Power.	6 Horse Power.	7 Horse Power.	8 Horse Power.	9 Horse Power.	10 Horse Power.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
110	50·90	63·64	76·36	89·09	101·80	114·55	127·28
120	46·66	58·33	70·00	81·67	93·33	105·00	116·66
130	43·08	53·85	64·61	75·39	86·16	96·92	107·70
140	40·00	50·00	60·00	70·00	80·00	90·00	100·00
150	37·33	46·67	56·00	65·33	74·66	84·00	93·34

The following Table II. gives the performance of the first and second prize engines at the meetings of the Royal Agricultural Society for six years, 1849, 1850, 1852, 1853, 1854, and 1855, and the two highest at the Paris Exhibition of 1856, showing a progressive increase in the duty obtained.

TABLE II.

Duty performed by Portable Agricultural Engines.

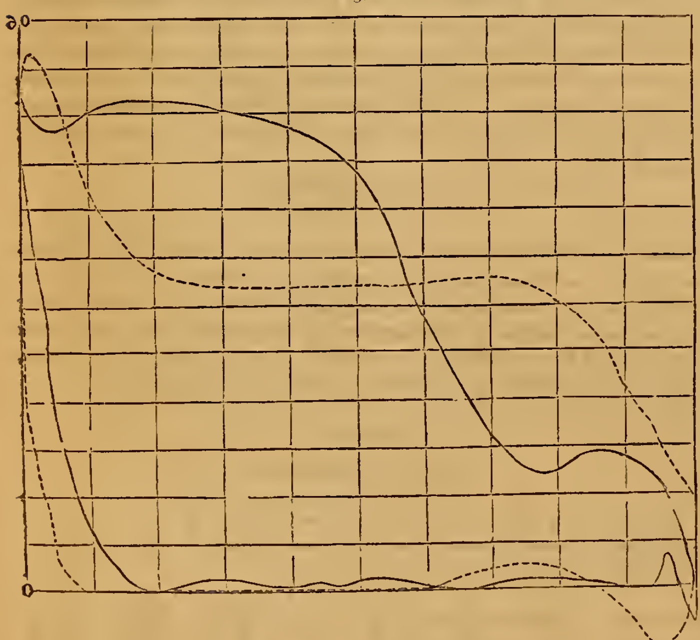
Year.	Place at which Show was held.	Duty performed. Coal burnt per horse power per hour while doing the work.	
		First prize.	Second prize.
		lbs.	lbs.
1849	Norwich	11·50	10·78
1850	Exeter	7·56	7·77
1852	Lewes	4·66	5·45
1853	Gloucester	4·32	4·82
1854	Lincoln	4·55	5·10
1855	Carlisle	3·70	4·05
1856	Paris	3·50	4·00

It will be remarked that the duty performed in 1853 is higher than that in 1854; this arose from the fact that, exclusive of the 14 lbs. of coal per horse power weighed out to the enginemen to get up steam and run the engines, they were allowed to fill the firebox in addition; but in 1854 this practice was stopped, and the fireboxes were swept out to prevent any advantage in this respect. It will thus be seen that the duty represented prior to 1854 is more or less fictitious.

Table III. (appended) gives the general results of the trials of the portable agricultural engines at the shows of the Royal Agricultural Society for the six years previously named.

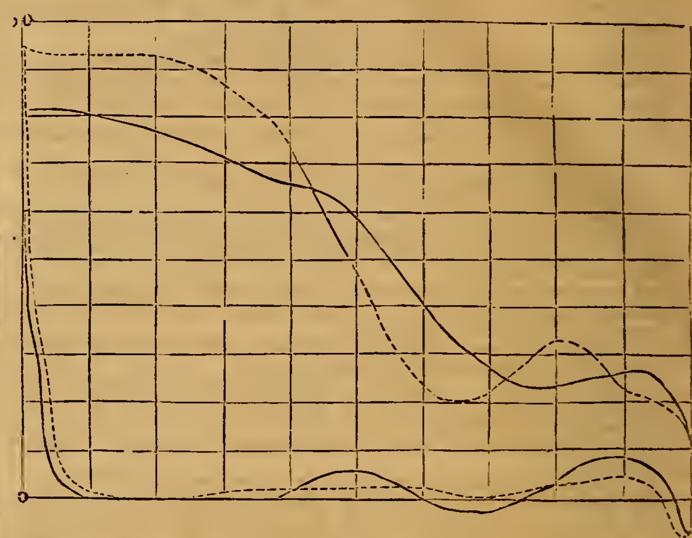
Indicator diagrams taken from four of the recent portable engines are given in Figs. 1 and 2; in each case the engine was working with an 8 horse power weight in the scale of the dynamometer. In Fig. 1, the full line is taken from an engine with a cylinder 7 inches diameter, and having $1\frac{1}{4}$ in. lap of the valve, making 115 revolutions per minute; and the dotted line is from an engine with a cylinder 7 inches diameter, and having $\frac{3}{4}$ in. lap of the valve, making 150 revolutions per minute, the

Fig. 1.



duty being 4·40 lbs. of coal per horse power per hour. In Fig. 2, both the full and dotted lines are taken from engines having a cylinder $8\frac{1}{2}$ in. diameter, and $\frac{3}{4}$ in. lap of the valve, with an additional back cut-off valve, making 115 revolutions per minute; the engine from which the dotted line is taken, performed a duty of 4·05 lbs. of coal per horse power per hour.

Fig. 2.



In the several engines described, some points of essential practical difference have been alluded to in passing, which demand a more special consideration; and of these the cylinder, as one of the most important may be noticed first.

The cylinder is in some cases exposed on the top of the firebox unlagged, and in others it is placed in the same position, but is covered sometimes with lagging and sometimes with a steam jacket also. A cylinder felted and lagged will of course be more economical than one exposed to the atmosphere, by rendering available the steam otherwise lost in condensation. Then we have the cylinder placed in a chamber in the smokebox, over the firebox or at the opposite end to the firebox, with the exhaust steam turned into the chamber. Again, the cylinder is placed in the steam chamber over the firebox, increasing the size of the steam chamber, and consequently the area of the plates exposed to the atmosphere. In other engines the exhaust steam is thrown into a jacket round the cylinder; while in others a steam jacket is provided round the cylinder, thus increasing the surface for condensation.

A further improvement gives the advantage of the steam jacket exposed to gases at a higher temperature than the steam, so as to prevent any loss by condensation, and to gain if possible, by superheating, the steam on its passage to the cylinder. That there is a possibility of a gain may be gathered from the fact that steam at a pressure of 100 lbs. per square inch has a temperature of 342° Fahr.; and at a pressure of 50 lbs. per square inch a temperature of 300° Fahr.; or in round numbers one degree gained in the temperature is one pound gained in the pressure on the piston, while the indicator on the boiler remains unchanged.

In all the above arrangements, and in most engines of modern make, the cylinder is placed horizontally; and although there can be no doubt as to the superior durability of a vertical cylinder, the latter is not at all times the most convenient arrangement. In one make of engines that has been described the cylinder is placed vertically, and the engine is housed to protect it from dirt and grit; in this respect the plan is an improvement, but the heat of the house or chamber is too great to admit of economy of oil or tallow, and the position of the cylinder below the water line of the boiler is certainly conducive to priming, by converting the steam pipe into a syphon.

The slide bars or guides are made either single or double, but whether two or four bars are most economical is still open to discussion; and the difficulty of getting four slide bars adjusted may be weighed against the uneven wear of the double-ended or forked connecting rod. The three modes of adjusting the bars or blocks to the wear are noticed above. Another plan has been proposed, having one guide only fixed on the boiler independent of the cylinder, and therefore liable to be acted upon by the expansion of the boiler. These are matters of detail, and the last plan has no doubt the advantage of easy construction, although a very slight derangement would have the effect of throwing the connecting rod atwist.

The length of the connecting rod most economical in practice, in proportion to the length of stroke of the engine, requires some notice. The old engine had a connecting rod 1 ft. 7 in. long from centre to centre of eyes for a stroke of 10 in.; more modern engines have a rod about 2 ft. long for a stroke of 11 in., or sometimes 10 in., as in an engine exhibited at Lincoln; while some have a rod as much as 4 or 4¼ times the length of the stroke.

The crank shafts of some engines are made of a straight bar with collars on it, having a crank arm keyed on at the end, and of course can give off their power only from one end; while others for greater convenience have been made with double or return cranks with square jaws; but as the latter are forged solid, and then slotted out, the pile or grain of the iron is necessarily cut in two. A simpler, and in the writer's opinion a stronger shaft, is that formed of a bent bar, jumped where it is to be bent, and brought into shape in a mould, the pile of the iron being thus kept in the direction of the strain exerted in the pull. It is worthy of remark that in the shafts of portable engines allowance is generally made for the expansion of the boiler, by putting collars on the shaft at the journal nearest the crank only, two collars being made to the one journal, and leaving the plain shaft to pass through the other bearing, so as to yield to the expansion, the cylinder going with the crank and the bearing at that end of the shaft.

In the governor of an engine the complaint is generally that when most required it is of least use. In the more recent engines the pendulums are shorter and the weights increased in size, and leather driving bands are used, being found most advantageous. The throttle valve should be close to the steam chest in order to govern the engine properly, as there will then be but a small quantity of steam past the valve. A more compact arrangement, or one more delicate in working, cannot be found than that already described.

The general plan of boiler for the portable engine has tubes connecting the firebox and smokebox, on the plan of the locomotive engine; the firebox has water spaces round, and the crown is stayed with cross supports, the sides also being held to the plates of the outside box by screwed stays rivetted over, or with nuts on one or both ends.

The arrangement of tubes varies with different makers; but the arrangements with irregular spaces, increasing as they approach the bottom of the boiler, have been found after eighteen months' trial to answer exceedingly well, and the writer believes that neither of these plans has been brought under special notice. Much doubt is still expressed as to the best way to arrange tubes for economy of working and urability of the tube plate. One of the plans is identical with the old plan, except that the rows of tubes run vertically instead of horizontally.

An important feature in a boiler is the shape of the crown of the firebox. If the water in circulation is considered to take the form of a curve from either side of the box on leaving the plates, it would naturally result that the nearer this shape is followed the better effect will be produced; but if the water leaves the plates abruptly and rises nearly perpendicularly, the straight side may be continued. The writer believes that a firebox rounded on all sides except the tube plate would allow of better circulation, and consequently make more steam than one with straight sides. Experiments have proved that flame will pass over a plain flat plate without imparting so much heat as when a number o studs or projections impede the progress of the flame and conduct the heat into the water; this should show the fallacy of attempting to obtain a high duty with very smooth firebox surfaces. Projecting stays, and plates bent in an easy curve to the tubes, so as to allow a free passage for the flame, seem to be the desideratum. The only fireboxes with rounded plates that have fallen under the notice of the writer, in portable engines, are by Messrs. Robey and Co., and that in the Carlisle prize engine. The ashpan firebox, or closed bottom firebox, is said to cause an important saving of fuel over the ordinary plan, but further experiments are necessary to prove the exact saving effected. In the boiler the firebox has a semicircular flue with a flat Tuxford top running along the boiler, the top being stayed to the bottom of the flue by a midfeather of some length. A small chamber next the engine-house receives the end of the flue, as well as the tubes, which convey the smoke and gases to a second chamber at the firebox end, whence the chimney passes up through the steam room of the boiler, carrying the smoke away.

Before quitting the subject of the boiler, it will be well to state that in those racing engines by which the highest duty has been performed in 1854 and 1855, there has been the smallest quantity of water. The tubes are set out with the smallest possible water spaces, and the barrel of the boiler is nearly filled with them; the area of the firegrate is reduced to a minimum, the coal used being Welsh, and requiring less air for combustion than any other. The following extracts from the report of the judge of the North Lincolnshire Agricultural Show, at Boston last year, will give a few particulars of the two engines tried there, the other being far behind.

"Messrs. Tuxford's engine, 8 horse power nominal; time in getting up steam, 2 hours 5 minutes; coal burnt in getting up steam, 29·28 lbs.; coal burnt per horse power per hour, 4·59 lbs. Messrs. Tuxford's engine worked out the best duty, giving a saving of 44 lbs. of coal per day of 10 hours;" but it is added that the length of time in getting up steam more than counterbalanced this saving. "This engine contained 89 tubes in the boiler, of 2 in. diameter, but furnished with ferrules at the firebox end, reducing their internal diameter to 1⅛ in."

"Messrs. Hornsby's engine, 8 horse power nominal; time in getting up steam, 53·5 minutes; coal burnt in getting up steam, 32·17 lbs.; coal burnt per horse power per hour, 5·14 lbs. Messrs. Hornsby's boiler was furnished with 61 tubes, tapering from 2⅜ in. diameter in the smokebox to 2 in. diameter in the firebox."

The coal used was common Yorkshire coal, such as is generally used for this class of engine.

The benefit of the prizes given by the Royal Agricultural Society for the last few years has been doubtful; firms have been at great expense to construct *one* engine which should perform the highest possible duty for the sake of getting the prize, and every effort has been concentrated on this one object, but no alteration has been made in the general or commercial engines. The farmers, whom these trials were meant to benefit, are no gainers by them; the racing engines would be unsafe in their hands without an experienced engineman, owing to the contracted water spaces; and although the trials may tend to develop the results of careful experiment and mechanical skill, and may be of interest to the mechanical world, yet they are not of any use to the agriculturist, unless those engines tried at the shows are required to be on the same plan, and similar in every respect to the commercial engine of the same firm. The trials of the Royal Agricultural Society of England are to be only triennial, and before 1858 we may expect to find a much higher duty than we can even now boast of; but the fairest way would be to try the commercial engines built by the several firms, and allow no difference to be made unless in finish and painting. The real working capabilities would then be tested, and farmers and the public generally would have some criterion to go by, and the trials would prove a boon. Such is now the case with mills, threshing machines, and other implements, and why engines should be excepted from the general rule it is difficult to say.

The variety of purposes to which the portable engine is applicable is very great, and its use is being now rapidly extended.

The portable engine is particularly qualified for winding light weights, such as bricks and mortar for building purposes, by means of a second shaft fixed on the boiler. By being placed on a carriage it has also been used to work one or more crabs for pile driving. The portable engine was pressed into the service of our country to draw stores from Balaklava to Kadikoi in the Crimea, until the locomotives were sent out; it worked the rope which supplied ammunition to the front, pumped water for the troops, and was placed on the deck of a vessel in the harbour to unload vessels arriving with stores; it proved useful in war, and in peace its usefulness is continually increasing; shod with an endless railway and made locomotive, it was then used to draw the guns and heavy ammunition where the feet of horses failed, and now, similarly harnessed, is employed to plough and harrow the ground.

The portable engine is yet only in its infancy, but has been brought on fast in its sphere of usefulness. Among the most important recent applications to agricultural purposes are, Willis's Farmers' Locomotive Portable Engine, Boydell's Traction Engine, Usher's Steam Plough, the various cultivators that have been brought forward to till the soil, and the several plans that have been employed for threshing, dressing, and grinding, &c. The transition from the use of animal power applied direct by treading or dragging some instrument over the full ears of corn, to the substitution of machinery, forms an important and interesting subject, with the advances from the various "horse gears," as they are technically called, to the gradual use of steam; the introduction of which was effected against prejudice, aided in many cases by the insurance offices, some of which refused altogether to insure the property where portable engines were allowed to work, and others accepted it only at a very high rate.

In regard to the application of steam power to the tillage of the ground, it is necessary to consider the manner in which this is practicable. In some instances it has been attempted to make the engine turn a set of knives or breasts similarly shaped to those known as "shieldboards" or "mouldboards" in ploughs, placed on a revolving drum driven by the engine; in others it has been proposed to use plain knives to cut at a fixed or variable depth below the drum or roller to which they are attached. Some have tried to give a straight vertical motion to a spade, or set of digging instruments, causing it to enter the ground a certain depth, and then an end motion, by which the earth is thrown behind or merely turned over. Another plan put in practice has been, to make the portable engine locomotive, dragging a frame of ploughs and harrows behind it; this is one of the plans now competing for the prize of £300 offered by the Royal Agricultural Society.

The vital point in the application of steam in the place of animal power consists in the following essential distinction:—the horse to give out his power effectively must move at a slow speed and in a direct line, whereas the engine must give off its power at a high speed and by a rotary motion; or in other words, the quick rotary motion of the engine must be converted into a slow direct motion, before it can be applied to pulling ploughs and cultivators as at present constructed for animal power. In this connection also arises the question whether a rotary or direct motion is the best for the purpose to which it is sought to be applied.

These are points of great mechanical importance, and attracting particular attention at the present time; and may perhaps be considered desirable as the subject of a further paper on a future occasion, in which the writer will be happy to aid.

If the present paper has supplied any information or led to the expression of any opinions tending to advance the cause of mechanical engineering, the object with which it was written will be attained; and the writer has the satisfaction of contributing his mite to the proceedings of the Institution.

TABLE III.—PORTABLE AGRICULTURAL ENGINES.

Results of the Trials at the Shows of the Royal Agricultural Society. Extracted from the Reports of the Judges.

Name of Maker.	Horse Power.	Duty performed. Coal burnt per H.P. per hour while doing the work.						Time of Raising Steam from cold water to 45 lbs. per square inch.						Coal burnt in Raising Steam from cold water to 45 lbs. per square inch.						Wood burnt in Raising Steam from cold water to 45 lbs. per square inch.					
		1849	1850	1852	1853	1854	1855	1849	1850	1852	1853	1854	1855	1849	1850	1852	1853	1854	1855	1849	1850	1852	1853	1854	1855
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	mins.	mins.	mins.	mins.	mins.	mins.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Alchin and Son	6	..	..	..	..	8·50	..	..	..	..	..	42	..	..	..	..	..	..	..	..	..	..	..	..	..
Bach and Co.	4	..	..	..	9·73	..	..	..	..	..	40	..	..	..	..	..	17·5	..	..	..	..	..	20	..	..
Barrett, Exall, and Andrewes	4	..	..	11·45	..	..	..	..	..	36½	..	..	..	..	..	20·7	..	..	..	..	..	20	..	..	..
Ditto	6	..	..	5·45	6·09	..	4·42	..	..	49	41	..	65	..	..	23·5	20·0	..	18·2	..	..	20	20	..	18
Ditto	7	..	10·55	..	..	..	..	..	81	..	..	..	..	..	49·2	..	..	..	..	..	20	..	..	..	..
Batley	6	..	13·85	..	13·53	..	..	..	85	..	43	..	..	..	64·0	..	17·5	..	..	..	20	..	20	..	..
Clayton, Shuttleworth, and Co.	4	..	..	8·40	4·32	..	..	..	..	41	47	..	..	..	..	29·5	17·5	..	..	..	..	20	20	..	..
Ditto	5	11·80	..	..	..	..	..	44	..	..	..	..	..	32·2	..	..	..	..	..	20	..	..	..	..	..
Ditto	6	..	..	6·00	..	5·19	..	..	..	32	..	39	..	..	..	22·7	..	..	..	..	..	20	..	..	..
Ditto	7	10·78	7·77	..	..	..	..	45	43	..	..	..	..	37·7	36·5	..	..	..	..	20	20	..	..	..	..
Ditto	8	..	..	..	..	..	4·05	..	..	..	..	..	44½	..	..	..	..	..	18·2	..	..	..	..	..	24
Crosskill	6	..	..	..	..	13·50	8·08	..	..	..	..	38	66	..	..	..	..	..	30·0	..	..	..	..	..	18
Garrett and Son	5	..	..	9·90	6·79	..	..	..	..	69	33	..	..	..	..	34·1	31·3	..	..	..	..	20	20	..	..
Ditto	6	11·50	11·29	7·10	..	5·62	..	63	34	32	..	39	..	73·5	34·0	19·1	..	..	..	20	20	20	..	..	..
Ditto	6	14·00	..	..	..	..	..	61	..	..	..	..	..	59·7	..	..	..	..	..	20	..	..	..	..	..
Ditto	7	..	..	..	..	..	5·61	..	..	..	..	..	44	..	..	..	..	..	26·0	..	..	..	..	..	21
Holmes and Son	4	..	..	..	9·61	..	..	..	..	..	45	..	..	..	..	..	25·9	..	..	..	..	..	20	..	..
Ditto	5	..	..	..	..	8·46	..	..	..	..	..	39	..	..	..	..	..	..	..	..	..	..	..	..	..
Hornsby and Son	4	..	..	6·05	..	..	..	..	..	47	..	..	..	..	..	24·9	..	..	..	..	..	20	..	..	..
Ditto	6	14·20	..	4·66	4·82	..	..	92	..	50	42	..	..	46·2	..	30·2	29·5	..	..	20	..	20	20	..	..
Ditto	8	..	..	..	..	4·55	4·84	..	..	..	..	40	39	..	..	..	..	..	34·5	..	..	..	..	..	24
Ditto	9	..	7·56	..	..	..	..	..	39	..	..	..	..	..	42·0	..	..	..	..	..	20	..	..	..	..
Ransomes and Sims	4	..	..	9·50	..	..	..	..	..	50	..	..	..	..	..	24·2	..	..	..	..	..	20	..	..	..
Ditto	6	..	..	8·03	5·50	..	..	..	..	56	229	..	..	..	..	33·2	28·5	..	..	..	..	20	20	..	..
Ditto	6	..	..	..	9·07	..	..	..	..	..	65	..	..	..	..	..	30·3	..	..	..	..	..	20	..	..
Ditto	7	..	..	..	..	5·10	5·05	..	..	..	..	51½	55¼	..	..	..	..	..	26·7	..	..	..	..	..	21
Robey and Co.	7	..	..	..	..	12·28	..	..	..	..	..	47	..	..	..	..	..	..	..	..	..	..	..	..	..
Tuxford and Sons	4	..	..	11·90	..	6·42	..	..	..	35½	..	33	..	..	..	21·4	..	..	..	..	..	20	..	..	..
Ditto	4	..	..	8·48	..	..	..	..	..	52	..	..	..	..	..	22·1	..	..	..	..	..	20	..	..	..
Ditto	6	..	11·06	..	6·51	..	..	..	90	..	44	..	..	..	44·0	..	29·3	..	..	..	20	..	20	..	..
Ditto	8	..	..	..	..	..	3·70	..	..	..	..	..	66	..	..	..	..	..	28·0	..	..	..	..	..	24

(*To be continued.*)

TONNAGE REGISTRATION COMMITTEE—BRITISH ASSOCIATION.

The committee appointed by the British Association to consider the deficiencies of the present registration of ships' tonnage and of marine engine power, and to propose a more perfect system with a view to the capabilities of ships for carrying "weight" as well as "bulk," and the actual working capabilities of the engines being more perfectly set forth in the official registration of shipping, request the opinions of persons practically and scientifically conversant with these subjects, or any of the points of inquiry referred to in the accompanying papers, and will be obliged by such opinions being forwarded to "The Secretary of the Tonnage Committee, Society of Arts, Adelphi, London," by the 1st of December, *if possible*, or not later than the 15th of December, for the information of the committee preparatory to their meeting in January.

The committee appointed by the British Association "to inquire into the defects of the present methods, and to frame more perfect rules for the measurement and registration of ships and of marine engine power, in order that a correct and uniform principle of estimating the actual carrying capabilities and working power of steam-ships may be adopted in their future registration," being desirous to consider the matters referred to them in all their bearings, will be obliged by being apprized of the views of parties practically conversant with the matters referred to on any of the following points; and they request that communications thereon may be addressed to "The Secretary of the Tonnage Committee, Society of Arts, Adelphi, London," on or before Monday, 1st December, 1856:—*

1st. To particularize the objects of public utility, fiscal, mercantile, scientific, and statistical, sought to be attained, or which may be promoted by a complete system of measurement, and comprehensive registration of the tonnage capabilities of ships, and of the engine capabilities of steam-ships.

2nd. Admitting that the present system of tonnage admeasurement, as prescribed by the Merchant Shipping Act of 1854, giving the *internal roomage* of ships, affords useful data for registration so far as it goes, what are the additional details of admeasurement which are required to give the capability of ships for carrying *weight of cargo*, and in other respects necessary to render the official registration of shipping, as periodically published by authority in the Mercantile Navy List, complete and effective for the objects of public utility above referred to.

3rd. To particularize in what respects the present system of tonnage and engine power admeasurement and registration, as prescribed by Part 2nd of the Merchant Shipping Act of "1854," is deficient and not effective for the attainment of the objects of public utility above referred to.

4th. Following the example of limitations commonly prescribed by Government in matters wherein public safety is concerned, such, for example, as protection from fire in Building Acts, what are the objections to the official assignment of some limit to the load draught of water, based on ordinary conditions of protection from wreck, at which ships may leave port; and presuming on the necessity for some limit being assigned which the draught of water may not exceed, by what rules may this limit be most correctly determined, and by what regulations may it be most effectually enforced without involving unnecessary interference with mercantile shipping transactions?

5th. In what respects is it commercially equitable, or in other respects advisable, to make a discriminative distinction between sailing ships and steamers in the measurement of the registered tonnage on which dues may be charged on shipping?

6th. In what respects is it commercially equitable, or in other respects advisable, in the measurement and calculation of registered tonnage, to make a discriminative distinction, based on the different materials (whether wood or iron, or a combination of both) with which ships may be built, or on the different principles of machinery (whether paddle wheel, screw propeller, paddle and screw combined, water jet, or other appliance) with which ships may be fitted?

7th. Seeing that no definite measure of power has been specifically fixed by law as the statute unit of mechanical power (as has been done to regulate all other measures of quantity, as in the cases of the statute yard, the statute acre, the statute gallon, the statute pound, &c.), and seeing, moreover, that in the practice of trade, the "nominal horse power" of a steam-ship does not define the measure of power available for the propulsion of the ship (the capability of engines for the production of working power with reference to their nominal horse power being notoriously, in some cases, the double of what it is in others), what steps should be taken to remedy this incongruity; and, presuming on its being determined to adopt some specific measure of power as the legalized standard unit of power, what definition, measure, or amount of power, should (in the opinion of the respective members of this committee) be adopted as the statute unit of marine engine power, and by what *name* should it be called, viz., whether "horse-power," or "marine horse-power," or "statute power," or "units of power," or other denomination?

8th. The respective members of committee are requested to state their opinion whether it be advisable that any particular mode of prosecuting the details of measurement and working out the calculations thereof (such, for example, as Sterling's rule) should be prescribed by law for the measurement of ships, as is done by the Merchant Shipping Act of "1854;" or, ought the system of taking the measurements and working out the calculations to be left to the discretion of the chief officer of the department on whom the responsibility for the scientific prosecution and accuracy of the calculations will professionally rest, as in the case of the astronomical calculations for the Nautical Almanac published by Government, but for which the system of prosecuting the observations, and deducing the calculations ,is not prescribed by law, but determined and improved from time to time, as may be, by the astronomer; and if it be considered that a prescribed mode of working out the calculations ought to be fixed and enforced by law, is the rule (Sterling's) now enforced by the Merchant Shipping Act the best rule now known and practised for calculating the cubature of ships?

[* This date does not apply to the general public, shipowners, &c., but only to local marine boards.—Ed.]

PROCEEDINGS OF THE FRANKLIN INSTITUTE.

COMMITTEE ON SCIENCE AND THE ARTS.

REPORT ON AN IMPROVEMENT IN FEED APPARATUS,

Invented by Jacob Frick, of Philadelphia.*

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination, "the Improvement in Feed Apparatus," invented by Jacob Frick, of Philadelphia,

Report,—That it consists of a check valve, blow-off valve, and safety-feed valve, with an alarm apparatus attached, each having its own distinct chamber, and all contained in one compact instrument. The check valve is of the usual puppet kind; the blow-off valve is a three-way cock, whose passages complete the communication between the boiler and check valve chamber, when the feed-water is passing into the boiler, or between the blow-off pipe and the boiler when the latter is being emptied. The safety-feed valve is the same as used heretofore, with a lever bearing upon the valve, and weighted to give a rather greater pressure per square inch than is had in the boiler, and which, by rising when the communication between it and the boiler is closed, permits the water to pass away through the waste pipe.

The alarm apparatus is operated by the waste water passing through a cylindrical chamber, in which slides a piston valve that is forced downwards by the pressure of the water, until several grooves cut in the wall of the chamber, parallel with its axis, are uncovered sufficiently to allow the water to pass through them and beyond the piston, and re-enter the chamber and pass away through a pipe attached to it. When the return stroke of the feed pump relieves the valve of the water pressure, it rises by the action of a spring coiled around its spindle, and thus vibrates a bell, which may be placed in any part of the engine-room, or in the office, and notify to the attendant or proprietor when the supply to the boiler is cut off.

The Committee commend the inventor for the ingenuity shown in the arrangement of the various parts ordinarily used for the purposes set forth, and for the excellence of the workmanship of the model, and consider that when a cock is interposed between the check valve and the boiler, it would be useful, by preventing the bursting of the feed pipes, if the communication should become closed by the shutting of the cock or obstructions in the pipe.

The single attachment (although much used on the cylinder boilers of stationary engines) cannot be considered an advantage; for, if the supply water be impure, the blow-off pipe should be attached to that part of the boiler where its contents are most quiescent, as the foreign particles always tend to such a place, and subside; this can never be near the attachment of the supply pipe, even though at a point where, by the disposition of the fire surface, the ebullition is least; for the current of entering water will prevent any matter from settling near it.

By order of the Committee,

Philadelphia, August 14th, 1856. William Hamilton, *Actuary*.

Description. By H. Howson.

This invention consists in the combining together in one instrument of a check valve, stop valve, and blow-off valve for steam boilers, in such a manner that the whole may be secured to the boiler by one attachment only, thereby avoiding the necessity of piercing and wounding the boiler in several places for the purpose of making the separate and distinct attachments hitherto employed for the same purpose; it further consists in employing in connexion with the above combination of valves and cocks, a safety valve, and alarm apparatus, fully described hereafter, for the purpose of notifying the attendant engineer when any undue obstruction is offered to the regular flow of water from the feed pump to the boiler.

On reference to the annexed illustrations—

Fig. 1, is an elevation (partly in section on the line 1—2, Fig. 3).

Fig. 2, a sectional elevation of the same on the line 3—4, Fig. 3.

Fig. 3, a sectional plan on the line 5—6, Fig. 1.

The same letters of reference allude to similar parts throughout the several views.

A is the chest containing the check valve, and B the casing of the combined stop and blow-off cock. Cast to, and projecting at right angles to each other from the casing B, are the hollow projections, C and D; the former screwing into, and communicating with, the steam boiler, and the latter forming the blow-off passage. E is the plug of the stop and blow-off cock, having one opening, *a*, directly through it, and another opening, *b*, communicating with *a* at right angles.

These openings are so arranged that when the plug is turned to the position shown in Fig. 3, there is a direct communication from the check valve through the opening *a*, and through the interior of C to the boiler; but when turned in the direction of the arrow, so that the opening *b* coincides with the interior of the projection, C, the passage from the check valve is stopped, and a communication opened between the boiler and the blow-off passage D. The top of the plug E is furnished with a projection, *d*, which strikes against projections on the top of the casing B,

* From the Journal of the Franklin Institute.

and prevents the said plug from being turned to any other positions than the two above described. F is the check valve operating and having its seat in the chest A, the upper stem, *e*, of the valve moving in an orifice in the cover, G, of the chest, and the lower stem, *f*, moving in the opening of the projection H.

Below the valve the interior of the chest communicates by the curved

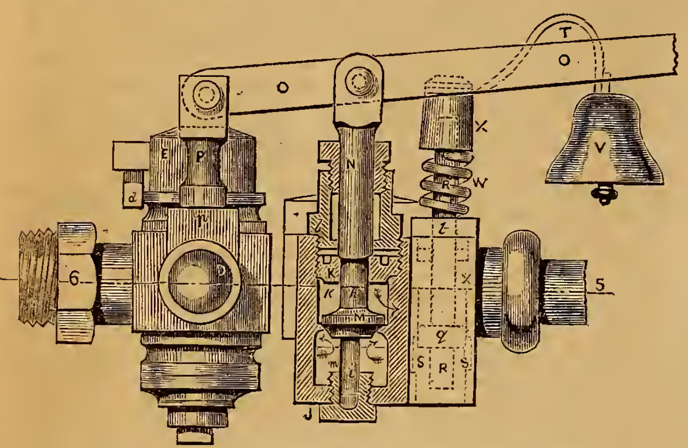


Fig. 1.

passage, I, with the feed pipe, J, which screws into the hollow projection K. To the chest, A, of the check valve is cast the chest, L, of the safety valve M, below the seat of which the two chests communicate with each other by the passage *m*. The lower stem, *i*, of the safety valve, M, moves in the nut, *j*, which screws into the bottom of the chest, L, and the upper stem, *h*, in the nut, *k*, below the stuffing box, *t*. Through the latter passes the rod N, the end of which bears on the top of the stem, *h*, of the safety valve, its upper end being jointed to the lever, O, which has its fulcrum on the stud P, the latter being screwed into a projection, *p*, on the blow-off passage D.

Cast or otherwise secured to the chests, A and L is another chest, Q, the lower part of which is bored out for the reception of the piston, *q*, on the rod R. Above the piston, *q*, the interior of the chest, Q, communicates by the passage, *n*, with the space between the valve, M, and nut, *k*, in the chest L.

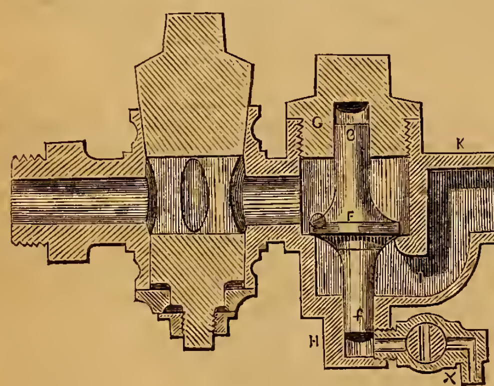


Fig. 2.

The interior of the chest Q, in which the piston, *q*, operates, has several grooves, S, the top of which are covered by the piston when the latter is at rest; but when moved downward by the action (hereafter described), a passage is formed from the space in the chest L, above the valve M, through the passage *n*, and down the groove S, through the bottom of the chest Q. The latter is furnished at the top with a stuffing box, *t*, through which passes the piston rol R.

This rod is furnished at the top with a nut, *w*, between which and top of the stuffing box gland, *t*, intervenes a spiral spring, *w*, which has a tendency to keep the piston, *q*, with its rod, in the position shown in Fig. 1, when not otherwise depressed.

In order to prevent the piston rising too high, the rod is furnished with projections, *x*, which fit against the shoulder in the chest Q.

To the top of the nut, *w*, is attached a spring, T, furnished at the end with a bell; or the top of the piston rod, R, may be connected by means of wires to any other suitable alarm apparatus within the hearing of the attendant engineer.

W is a cock for discharging any water which may collect in the chest A; above the check valve F and X, a similar cock for drawing the water, which may collect below the valve, in the projection H. Y is a plug which always remains screwed into the end of the projection D, as long as the latter is not used for blowing-off from the boiler.

The plug E of the stop and blow-off cock being in the position shown in Fig. 3, and the lever O weighted to suit the pressure in the boiler, against which the water has to be forced, a communication exists from the feed pumps through the pipe J, attached to the same, through the seat of the check valve F (which operates according to the action of the pump in the usual manner) and the plug E of the stop and blow-off cock to the boiler. Should the plug have been turned accidentally or otherwise, so as to obstruct the passage of the feed water to the boiler, the pump of the engine being still in operation, the excessive pressure occasioned by this obstruction, and the action of the pump combined, will cause the water to act on the underside of the safety valve M, and,

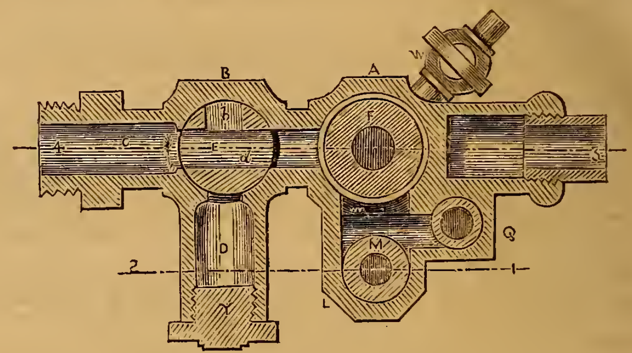


Fig. 3.

raising the latter, will pass through the opening *n* to the space in the chest Q above the piston *q*, passing down the latter until a portion of the water can escape down the grooves S, and at the same time causing the bell to ring. During the time the feed pump takes its upward stroke, this excessive pressure will cease, and the spiral spring *w* will raise the piston *q* to its former position; but immediately the down stroke commences, the depression of the piston takes place, and the alarm continues until the engineer either regulates the pump or the plug E of the stop and blow-off cock. When the latter has to be used for blowing-off the boiler, the plug Y is removed, and a bent or other pipe directed to an adjacent drain or sewer screwed into its place; the plug E is then turned until its opening, *b*, coincides with the passage through the projection C to the boiler, when a blow-off passage is immediately formed. When used as a stop cock only, for obstructing the feed water from the boiler, the plug Y is retained in the position shown in Fig. 3.

ON THE BRIDGES AND VIADUCTS OF THE PRESENT DAY.

THE CRUMLIN VIADUCT, &c.

(Continued from p. 159.)

My own professional engagement in the locality enables me to enter more at length into the description of the Crumlin Viaduct, situated on the Newport, Abergavenny, and Hereford Railway Extension, which, with the exception of the aqueduct of Spoleto and the Portage Timber Viaduct, in the United States, exceeds any other structure of the kind in height. It is a remarkable example of the modern application of iron to such purposes. The dimensions are as follow:—Total height from the bed of the river to the level of the rails, 200 ft.; the piers from centre to centre, 150 ft.; actual bearing of girder, 148 ft.; the total length of viaduct, 600 yards. There are altogether ten spans or openings, but they are unequally divided by a tongue of land on which are placed masonry and earthwork, about 50 yards in length, making in reality, as far as the ironwork is concerned, two separate viaducts. The larger viaduct has seven spans and six piers; the smaller one, three spans and two piers. Excepting the height of the piers from the level of the valley, the two are precisely similar, and it will be necessary only to allude to the larger one. The piers are formed of clusters of cast-iron columns, placed in stages. Each column is 17 ft. long by 1 ft. in diameter, cast hollow, the thickness of metal varying from 1 in. to ⅞-in., diminished within, the same external diameter and form of column being preserved throughout. The number of columns in each stage is fourteen, and they are arranged on plan, in the longer direction, in four rows of three each, with one standing singly at each end of the piers, which gives it a salient angular outline. The width between the columns at the base of the pier measures 13 ft. 6 in. in every direction, taken on the square, excepting between the centre rows, where it measures 6 ft. throughout the height. The pier gradually diminishes to the top of the columns below the girders, where the dimension 13 ft. 6 in. is reduced to 9 ft., and at the external angle columns to 2 ft. The dimensions of the piers at the base are between the centres of the columns 60 ft. by 27 ft., and the upper dimension is 30 ft. by 18 ft., giving a diminution of 30 ft. in one direction, and of 9 ft. in the other. To effect this, nearly all the columns are more or less inclined, and the two centre are the only upright ones. The four columns at the corners, forming the square of the piers, lean diagonally, 4 ft. 6 in. The six intermediate columns correspond, but lean each in one direction only. The two single outside columns are most inclined, being 11 ft. 6 in. out of the perpendicular, forming a raking brace. The top of each stage of columns is connected by horizontal cast girders, 1 ft. deep with 5 in. flanges, bolted together. There are also horizontal and vertical wrought tie rods. The former are circular, and 2 in. diameter, and the latter flat bars, 4 by $\frac{5}{8}$. They are tightened with wedges where necessary. The columns are fitted together with socket joints, a projection of half an inch being left on the top of the cap, which fits into the base of the column above. These are held together by four ears cast on the top and bottom, which are fixed with bolts and nuts. The joints of the columns are planed and fitted together with the greatest nicety to ensure a perfect bearing. The base plates upon which the columns stand vary from 3 ft. to 5 ft. in height, and have a plate 3 ft. square resting on the masonry, into which they are joggled, plugged, bolted, and put together with sulphur joints. The number of stages of columns to centre piers, it will be perceived, are ten, without base plates. The upper stages of the columns are connected together at top by stronger horizontal girders than those below. They are finished with A-shaped, or triangular trusses, placed over each row of columns below, upon which the girders rest. It should be mentioned that the foundations for the piers are formed of solid, flat-bedded, and jointed masonry: they were generally carried down to the solid rock, and vary from 10 to 3 ft. in depth. The largest blocks are placed immediately under the base of the columns, and so arranged as to distribute the weight below as much as possible. The girders are formed of wrought-iron, after Warren's patent. This consists of a stout beam above, and a bottom tie below, with diagonal filling in, the whole being supported by the top beam on the principle of an inverted truss: the mode of execution, however, differs much. The girders at the Crumlin are 150 ft. long, and 14 ft. 6 in. deep, outside dimensions. The dimension of the top tubular beam is $14\frac{1}{2}$ in. by 9 in.; the average thickness of the plates being, the sides an inch, the top and bottom half an inch. The sides have flanges formed on the edges, which are rivetted to the top and bottom plate. Extra stiffening pieces are carried along the bottom, and likewise the joints and where the bolts cross. The ties at the bottom of the diagonals of the girder are formed of a series of four wrought bars, 6 in. by $\frac{5}{8}$-in. average, placed in pairs 3 in. apart in the centre, to admit the diagonals and packing, and showing a 4-in. separation on face; the whole forming a square combination measuring 16 in. by 7 in.: these bars reach from diagonal to diagonal, where they are all four joined with a plate 16 in. deep, and bolted with five $\frac{7}{8}$-in. rivets to each. There are eighteen diagonals to each girder, which act as struts and ties until they gradually approach the centre, where they act as both. The diagonals do not cross each other, as is the case in the lattice girder, but are both fixed to the top beam and bottom tie with large bolts $3\frac{1}{2}$ in. diameter; and it is on the care and security with which these parts are connected that the chief strength of the girders depends. The diagonal ties and struts present a different section, the main strut being of a cross-shape, measuring 10 in. to each extremity, cut out of $\frac{7}{8}$-in. plates, with four 5-in. L angle pieces rivetted. The ties are formed of two flat iron bars 9 in. by $\frac{1}{2}$-in., which lap the struts, where they are rivetted, top and bottom. The ties near the centre, extending two on each side, are strengthened by smaller pieces of T iron, to enable them to act in some measure in the double capacity of ties and struts. The part of the lower beam or ties between the four centre strains of diagonals is strengthened by an additional bar 4 in. wide, filling the space between the other bars, and rivetted like them to the junction plates. The whole girder is gradually strengthened by an additional thickness of plates towards the centre, given by a close calculation of the forces required to be resisted. The side plates of the girder and ties diminish from 1 in. in the centre to $\frac{5}{8}$-in. at the ends. Each pair of girders is connected at each of the large bolts or pins with a 5-in. cast-iron hollow bar, with $\frac{1}{2}$-in. thickness of metal. The bolts are passed through the ties, diagonals, and packing pieces, leaving the heads outside, the ends of the pin projecting about an inch: the end is then covered with a cast-iron cap, which is screwed or bolted with a $1\frac{1}{2}$ in. screw into the centre of the pin, to prevent the same from drawing out. This affords a means of connection with the cast-iron bars by corresponding flanges, which are firmly bolted together. The bearing of the girder, by which the whole is sustained, is worthy of particular notice. It is held by the ends of the *upper beam only*, the lower one dropping in a state of suspension: the weight thus entirely rests on the last pin, which passes through the outside diagonal tie. The top of the angular termination of the piers is furnished with a casting 3 ft. 6 in. long and 5 in. wide, on the upper surface of which is a flat sinking $\frac{3}{4}$-in. deep. Under the ends of the upper beam are placed cast-iron blocks, hollowed out on the upper surface to receive half the diameter of the pin, and of sufficient depth to raise the bottom flanges of the beam clear of the sliding groove. This block has perfect freedom of play backwards and forwards, to suit the expansion and contraction of the girders, as affected by the temperature of the atmosphere, or the superincumbent weight: for this purpose a space of 9 in. is likewise left clear between the ends of the beams. The ordinary expansion and contraction in summer, between midday and midnight, does not exceed $\frac{1}{4}$ of an inch. The girders have been tested with a weight of 250 tons each, which produced a very slight deflection; and were the viaduct loaded with locomotives, this would be seven or eight times as much as could be put upon them. The struts have also been tested with a crushing weight of 250 tons. The roadway is formed of 6-in. planking, bolted to the beams, and it is intended that the rails should be laid on strong longitudinal framed sleepers. An ornamental cast-iron balustrade is fixed on each side of the roadway. The whole viaduct is not straight on the plan, the approaches to the larger one being curved, to which the last spans of the viaduct accommodate themselves by a slight inclination southwards at the extremities. This viaduct has been described as one of the engineering wonders of the day; and it may be mentioned that another, projected by the same engineers, is of much greater height. Messrs. Liddell and Gordon, engineers; Mr. M. W. Carr, resident engineer; Messrs. Kennard, contractors.

The Sitter Viaduct, on the St. Gall and Appenzel Railway, an account of the completion of which has just appeared, is one of similar construction, except that the girders are lattice. It is close upon the same height, and has four spans, the two centre being 138 ft., and the two side ones 130 ft.; but, on the whole, is a work of less magnitude than the Crumlin.

The Newark Dyke Bridge, crosses in one span a branch of the Trent at an angle so oblique as to render it necessary that the girder should be 240 ft. 6 in. long, whilst the width, measured on the square between the abutments, is only 97 ft. 6 in. This is also one of Warren's patent, but differs materially from the Crumlin, inasmuch as the top tube and the parts compressed are of cast-iron. Each line is carried by a pair of girders 13 ft. apart, between which the trains run. The top tube or strut is composed of twenty-nine cast-iron pipes, 13 in. diameter, the thickness of metal $1\frac{1}{2}$ in. The ends of these are turned and nicely fitted together and bolted: the cast-iron struts are of the form of a Maltese cross. Each girder weighs 122 tons 10 cwt.; the whole bridge, including the platform, 589 tons. The deflection caused by two heavy goods engines, travelling both fast and slow (60 tons weight), was $2\frac{1}{4}$ in. This bridge was erected before the Crumlin, and although the span is greater, the preference must be given to the latter, as being composed entirely of wrought-iron.

Chepstow Bridge, over the river Wye, by Mr. Brunel, is a remarkable example of the combination of the tube and girder, to which may be added a third principle, that of suspension. The whole length of the bridge is 623 ft., one-half of which is crossed by a viaduct girder of three spans, the remaining portion by a single span of 296 ft. The central pier is composed of six cast-iron cylinders 8 ft. diameter below, and placed in two rows of three each: the viaduct piers are in single rows of three in each. Two girders of uniform depth throughout, carry each line of rails: those above the roadway are perfectly distinct, and do not depend upon each other. 50 ft. above the large span a circular tube 9 ft. diameter is placed, from which the roadway to each is suspended. This is done by two vertical frames of wrought-iron, dividing the girder into three spaces, the centre the widest, the spaces braced with cross chains put together in links similar to suspension-bars. The main chains hang from the tube at the ends over the pier to the opposite corner at the level of the roadway, where they are joined across the centre on both sides of the girder, and the middle space is crossed by chains both ways, which gives additional security to the centre of the girder. The tubes are carried at each end on seventeen rollers, 5 in. diameter, which allow for expansion and contraction: the diameter of the pins which carry the leading chains is 7 in. The girders are formed of single wrought plates, with top angular casing 3 ft. wide, and a curved bottom flange. This girder is made strong enough for the 100 ft. spans; and over the space three times that width, it will be perceived that it is supported in two intermediate parts, so that in reality the girder has very nearly the same bearing throughout. This is an extremely ingenious arrangement, the sectional quantity of material used with reference to the span being less than in any like structure. But it is to be regretted that from its want of symmetry and its lop-sided appearance, it is by no means an agreeable design. The Great Saltash Bridge is on the same principle, with four spans, the two principal not less than 445 ft.

The objection to combination girders does not apply to those made all of wrought-iron. In cast-iron the girder is broken by the first deflection, but no mischief is done to wrought before the trussing-bars or suspension-rods are called into action.

The Boyne Bridge, on the Dublin and Belfast railway, is one of the finest examples of the lattice girder which has hitherto been executed. The main span is 264 ft. between the bearings: the two side spans 137 ft. At the end next the town of Drogheda are thirteen arches of masonry of semicircular form, 61 ft. span. At the other end are three similar ones. These are built of finely-wrought stone. The height of the bridge above water-mark is 100 ft., allowing the passage of shipping without striking top-gallant masts. The depth of the lattice girder is $22\frac{1}{2}$ ft. It is formed of top and bottom wrought tubular chords: the area of the top chord where the greatest strength is required, is 265 in., where the least 137: the lattices are placed on each side of the chord at an angle of 45 degrees, 7 ft. 6 in. apart, forming double squares in height: the sizes vary from 10 in. by $\frac{5}{8}$ to 4 in. by $\frac{5}{8}$, according to the strains: they are closely bolted to cross braces at the intersections. There is a double line of railway, with the girders on the outside, measuring 24 ft. 6 in. in the clear: the roadway is supported on cross beams, also on the lattice principle, 7 ft. 6 in. apart, covered with 6-in. planking bolted down. The girders being joined over the piers form one length, and are fixed only on one pier; the other supports being the usual rollers working in grooves to admit of expansion. Sir J. M'Neill was chief engineer. Mr. Burdon and Mr. Barton (to the latter of whom I am indebted for much information on the subject) were the resident engineers.

It will be perceived that the principle of the lattice girder does not materially differ from that of the large tube, the sides of the former being open with lattices where material is not so much required. With the same weight of metal the lattice girders will carry a greater load than tubes. The comparative duration has not yet been ascertained, but the lightness and elegance of appearance, and several other considerations, are greatly in favour of the lattice bridge. For further particulars useful reference may be made to notes of the comparative strength of the tube, Warren's, and the lattice girder, by Mr. James Barton, C.E. Various opinions have been also given by eminent engineers, which will be found in the "Transactions of the Institution of Civil Engineers."

In forming a comparison of the materials to be used for any particular work, whether a bridge or a viaduct, many questions have to be taken into consideration, but none more important than that of economy. To arrive at that, the original outlay and the probable durability must be taken into consideration; and from what has hitherto taken place, the conclusion arrived at appears to be in favour of wrought-iron; but it should also be noticed that metals can be destroyed by repeated vibrations, which have a tendency to separate the particles of which they are composed. As a sufficient excess of strength should be provided, this objection does not detract from the value of the material, while it demands additional skill and ingenuity on the part of the constructor.

THE CHEMISTRY OF IRON.

ON THE COMPOSITION OF SOME VARIETIES OF FOREIGN IRON.

By F. A. Abel.

Director of the Chemical Establishment of the War Department.

There are few subjects of practical importance that have, during the last twelve months, attracted general attention in this country to the same extent as the question of the manufacture of iron ordnance. While numerous plans have been proposed, discussed, and tried for constructing cannon, either of wrought-iron, steel, or mechanical combinations of iron material of different kinds, which shall be capable of throwing larger and heavier projectiles than those hitherto used, the question at issue has gradually become one of more general interest, involving considerations intimately connected with the metallurgy of iron, in consequence of the conclusions deduced from the experience in the late war, that the conditions necessary for obtaining a durable and uniform material for iron guns are as yet far from being fully determined.

The American government has lately published a collection of reports, containing some interesting and important observations connected with the manufacture of iron ordnance, though it does not appear that the researches carried on in that country, or the experience gained by the directors of gun foundries belonging to various continental states, have as yet effected much more than the provision of a number of data relating to the nature and quality of iron employed, the different methods of treating the metal and of casting the gun, and the effects of mechanical tests, and of the explosive force of powder upon iron ordnance. There is little doubt that the accumulation of such data, and extensive experiments suggested by their comparison, will ultimately lead to the establishment of the conditions necessary for insuring to iron ordnance uniformity and durability.

The collection in this country of such data as those referred to has hitherto been a matter of great difficulty, from the circumstances that iron ordnance were obtained by Government from various private sources; that no special conditions have been observed in the selection or treatment of metal for ordnance; that no records of the material employed by the different manufacturers have been preserved, and that no system of tests, physical or chemical, has been applied to the metal composing the guns, beyond the regulation proof to which ordnance were submitted before their acceptance from manufacturers. It is obvious, also, from these circumstances, that no uniformity in the iron guns used in this country could be expected.

Now that Government has determined to take the manufacture of iron ordnance into its own hands, the most serious obstacles to the perfection of these important arms in England are set aside, and the introduction of a complete system of testing and of record, together with the results of a very extensive series of experiments, on a sufficient scale, which have already been commenced, will, it is hoped, furnish important contributions to our knowledge of the constitution and mode of treatment of iron, best adapted for the manufacture of ordnance.

In carrying out the system of experiment determined upon by Government, attention has been directed, in the first place, to iron reduced from its ores by charcoal, this being the material employed exclusively, in some continental States, and to a very great extent in others, in the manufacture of iron ordnance. Much stress is laid, by many authorities on the continent, upon the greater fitness, for this purpose, of that description of iron than of the best hot-blast, or even of cold-blast iron, smelted with coal or coke. It appeared, therefore, naturally the first step, in comparative experiments with various materials, to ascertain the nature of the iron composing the most durable guns manufactured in those countries, and to determine, by comparative experiments here, whether guns manufactured from charcoal-iron exhibit great superiority over those made *according to the same system* of iron reduced from its ores by mineral fuel. Various specimens of foreign charcoal-pig-iron, and cannon of that metal made in France, Belgium, and Sweden, have been collected for comparative examination, and considerable quantities of charcoal-iron, procured from Nova Scotia, Sweden, and America, have been purchased, for experimental purposes. The results obtained, up to the present time, are principally those furnished by the analysis of several of these specimens; and I venture to submit these to the Chemical Society, as they exhibit some points of interest, and may also serve, to others engaged in similar inquiries, as additional means, to those already existing, of comparing the constitution of the varieties of charcoal-iron with that of other descriptions of iron.

It is unnecessary, in the present instance, to enter into analytical details; but, as various methods are employed by different chemists, for determining the most important constituents in iron, it may be advisable to furnish a brief outline of those adopted in performing the subjoined analyses.

The *graphite* was determined by digesting the finely-pulverised iron with concentrated hydrochloric acid, and boiling the residue for some time with a moderately-strong solution of potassa: the graphite was collected, washed, dried, and weighed. It was afterwards placed in a capsule and heated to redness in a muffle, until the whole of the carbon was burnt off. The weight of the slight incombustible residue which was generally obtained was deducted from the weight of the graphite.

For the determination of the *total amount of carbon* the iron was reduced to an extremely fine state of division; it was then first mixed with about twice its bulk of fine sand, or powdered glass, and afterwards with a mixture of chromate of lead and chlorate of potassa. The combustion was conducted in the usual manner, a current of oxygen being frequently employed.

The proportion of *silicium* was ascertained by acting upon the finely-divided metal with concentrated hydrochloric acid, evaporating to dryness, and digesting the residue with hydrochloric acid. The insoluble portion was collected upon a filter, washed until free from iron, dried, and ignited until the whole of the carbon was burnt off. The silicic acid thus obtained was digested with solution of potassa, after its weight had been determined. If any insoluble residue was obtained, its weight was deducted from that of the silicic acid.

To determine the proportion of *sulphur*, hydrochloric acid was allowed to act very slowly upon fragments of the iron, in a suitable apparatus, and the gas generated was passed through a slightly acid solution of acetate of lead. The sulphide of lead produced was collected, washed, and ultimately weighed as sulphate of lead.

The *phosphorus* was determined by digesting, in nitrohydro-chloric acid, fragments of the metal, of the size of small peas, evaporating the solution to dryness, digesting the residue with hydrochloric acid, and separating the insoluble from the soluble portion. The hydrochloric solution was partly neutralised by sesquicarbonate of ammonia, and the greater part, if not the whole, of the sesquichloride of iron reduced to protochloride, by sulphite of ammonia. Solution of acetate of ammonia was then added in excess, and afterwards a small quantity of solution of sesquichloride of iron. The phosphate of iron was precipitated by boiling, collected, and dissolved in hydrochloric acid, and decomposed by sulphide of ammonium. The phosphoric acid was estimated in the usual manner, as pyrophosphate of magnesia.

In the following Table is represented the per-centage composition of several specimens of iron, reduced from its ores by charcoal, as calculated from the analytical results :—

TABLE I.

Composition of Pig Iron smelted with Charcoal obtained from

	NOVA SCOTIA.			AMERICA.			FRANCE.	SILESIA.	
	Grey.	Mottled.	White.	Grey.	Mottled.	White.	Grey.	White, *very crystalline.*	White, *less crystalline.*
Specific gravity .	7·120	7·540	7·690	7·159	7·540	7·675	7·000	7·531	7·604
Iron........	95·20	95·35	95·25	94·87	96·35	96·55	95·18	93·45	90·75
Combined Carbon .	—	1·72	2·96	·04	1·14	2·79	—	4·94	3·62
Graphite....	3·11	1·38	—	3·07	1·50	—	3·40	—	—
Silicium	1·11	·26	·21	1·80	·79	·32	·80	·75	·25
Sulphur	·01	·03	·02	trace	·01	·06	·03	trace	trace
Phosphorus .	·13	1·30	1·53	·22	·20	·17	·45	·12	3·26
Manganese. .	·25	trace	—	trace	trace	trace	—	5·38	2·00
Copper	—	—	—	trace	trace	trace	—	·24	trace
	Traces of Titanium and Cobalt.						Traces of Arsenic and Chromium	Traces of Cobalt.	

The specimens of white iron from Silesia differ from one another in several respects, and to such an extent, as to prove that they were obtained from different ores. Both were very hard and brittle; but the ore containing the largest amount of manganese exhibited a foliated structure and brilliancy of lustre, very similar to that of refined antimony, while the other specimen, rich in phosphorus, was less brilliant and far more compact. These irons were proposed for admixture with dark grey iron; but it was considered that they could not be advantageously employed for this purpose.

The French iron examined was a specimen of the metal reduced by charcoal from hæmatite-ores, at the Government cannon foundry of Ruelle, and employed exclusively in admixture with charcoal-iron also reduced from similar ores in the neighbourhood, for the manufacture of ordnance. It was dark, soft, fine-grained, and uniform in texture. In its general characters it was similar to the Swedish grey iron analysed, though exhibiting a superiority over the latter in reference to the amount of silicium it contains.

The specimens of American and Nova Scotia iron analysed were taken as average samples from large parcels of the metal purchased by Government for experimental purposes.

The different varieties of iron from each source exhibit such differences in their composition as are generally observed in irons reduced from the same ore under modified conditions. Both the Nova Scotia and American irons are of excellent quality, and furnish the best results when submitted to physical tests. Comparative trials are about to be made of their merits as gunmetal.

The subjoined Table exhibits the results of the analyses of four specimens, from guns of foreign manufacture.

TABLE II.

Composition of Iron Gun Metal from

	BELGIUM.	FRANCE.	SWEDEN.	RUSSIA.
Specific gravity.........	7·250	7·250	7·050	7·135
Iron	95·61	96·02	95·87	94·36
Combined Carbon	·78	1·03	·18	·47
Graphite	2·12	1·87	2·62	2·83
Silicium	·99	·35	1·19	1·10
Sulphur	·06	·03	·08	·02
Phosphorus..........	·29	·45	·11	·37
Manganese	·15	·25	trace	·85
Titanium............	traces	traces	trace	trace
	Traces of Chromium, Arsenic, Zinc, and Copper.	Traces of Chromium and Tin.	Traces of Chromium.	Traces of Tin.

The Swedish metal examined has great resemblance to that composing the Russian gun which was one of those lately captured and selected for experiment. A severe proof to which this gun was submitted showed that the metal composing it was of excellent quality.

The Swedish metal was of a uniform light grey colour, while the Russian gun exhibited a slightly mottled appearance. Both contained the graphite in a finely divided state. It is worthy of remark, that the strength and durability of Swedish iron guns is found to be variable; which circumstance is ascribed to the very general practice of casting the guns directly from the blast furnace, instead of first submitting the metal to treatment in reverberatory furnaces.

The specimen of French gun-metal was obtained from the cannon foundry at Ruelle. It resembled, in a remarkable manner, several specimens of iron gun-metal obtained from the cannon foundry at Liège, of which the composition of an average sample is also given in the above Table. Both kinds were mottled iron of very uniform character, exhibiting a short and regular fracture, and a fine and compact structure. Their specific gravities are identical, and the differences exhibited in their composition are but slight. For the preparation of the French gun-metal, a mixture of various descriptions of charcoal pig-iron, obtained at Ruelle, is made with grey pig-iron, from other similar iron works in the neighbourhood (*e.g.* from *La Chapelle* and *Etouars*) with old French cannon, and with the "dead-heads" from former castings. By a protracted treatment in reverberatory furnaces, these metals undergo thorough mixture, and purification at the same time, and are converted into the uniform mottled metal above referred to. The fuel used for the remelting and mixing is Newcastle coal.

At the Belgian Government cannon foundry a certain proportion of hot-blast iron, smelted with coke, is employed in admixture with old cannon, "dead heads," and charcoal pig-iron, obtained from various smelting works, more particularly in the neighbourhood of Charleroi. The fuel used for the remelting is a semi-anthracite coal, from Belle Vue, in the neighbourhood of Liège, and has the following per-centage composition :—

Carbon	85·56
Hydrogen	4·20
Oxygen	2·40
Nitrogen	1·92
Sulphur..	1·00
Ash	4·92

The per centage of phosphoric acid in the ash is 1·60.

The same care is taken to ensure the production of a metal of uniform structure as at Ruelle; and the excellent results obtained by the proof of the guns, and by the mechanical tests to which the metal is submitted, bear very strong evidence in favour of the superiority of iron of the particular constitution and structure produced in Belgium and France, for the manufacture of guns, over other kinds of iron, even equal to it in chemical quality.

Unquestionably the repeated exposure of grey iron to a moderately oxidising action, in the reverberatory furnace, has the effect of improving its quality, and of removing one of the impurities most objectionable in iron which is to possess tenacity and elasticity—namely, silicium. In experiments lately made, in connection with some patent processes for improving the quality of iron, it was found that the oxidising action of air upon highly-heated iron had the effect of removing the silicium entirely, before the amount of carbon existing in the metal was diminished in any sensible degree. The close-grained and very uniform structure of the iron produced by the mixing and remelting processes, on the continent, and the very finely divided condition in which the graphite exists in the iron, are elements affecting the durability of the gun-metal, of equal importance to the purity of iron. Some pieces of iron ordnance which have either burst upon proof, or after having been but a short time in use, and the metal composing which was of good quality and even of an unusually pure description, evidently owed their incapability to resist the force of gunpowder to the comparatively loose structure of the metal, and to the existence of the graphite in large scales. There are, moreover, various points to be taken into consideration, in connection with the *method of casting guns*, which cannot be entered into here; but which, doubtless, greatly influence their physical structure, and, consequently, their durability.

It would be premature to attempt a comparison between the merits of charcoal-iron and those of the better qualities of British cold-blast iron, as materials for ordnance, from results of analysis alone; but thus much is certain, that iron smelted with mineral fuel may be obtained in abundance in this country, which contains not more phosphorus or sulphur than are found in average specimens of charcoal-iron, and that abundant proofs already exist of the ease with which silicium may be removed from pig-iron, by judicious treatment. It may, therefore, be confidently expected that future experiments on the casting of ordnance, with various kinds of iron, will prove that we are not dependent upon a supply of charcoal-iron, for the production of durable guns.

As an appendix to this communication, I beg to lay before the Society the results of an analysis of a specimen of the cast-steel manufactured by Krupp, of Essen, of which such beautiful specimens were exhibited at the Paris Exposition of 1855.

This cast-steel was proposed, by M. Krupp, as a material for ordnance, as far back as 1847, and the first small gun (a 3 pr.) cast of it was submitted to very severe tests, in Berlin, in 1849, and finally proved to bursting. A 12-pr. gun, of the same material, was afterwards sent for trial to this country (early in 1855), after having likewise withstood very severe tests. At about the same time, a cylinder of the cast-steel was sent from Essen, and bored by Messrs. Walker, of the Gospel Oak Works, to the calibre of an 8-inch gun. Its breech was fitted with a cast-iron case, or jacket, the thickness of which was 10 in. at the breech, and 8·5 in front of the trunnions. The weight of the gun complete was 8 tons 5 cwt. The case was in contact with the steel barrel only at its two extremities, at the breech and the middle of the barrel; at the latter place a wrought-iron wedge-ring was fitted into the barrel, and fixed to the jacket by screws. This gun was proved at Woolwich, but bursted the first time it was fired. The probable cause of this unexpected result has been a subject of some public discussion in Germany, but there is little doubt that it was due to the injudicious form of projectile (weighing 259 lbs.) which the parties who proposed to Government the experiments with cast steel, and provided the gun for trial, insisted upon employing for the proof.

The gun was broken into ten large pieces, and a number of small fragments. The various fractures of the cast-steel did not exhibit any imperfections, to which the bursting of the gun could have been ascribed. The metal was very uniform, compact, and hard. A fragment was selected for analysis, and furnished the following results:—

One hundred parts contained—

Iron	98·05
Combined carbon	1·18
Silicium	0·33
Phosphorus	0·02
Manganese	*trace*
Cobalt and Nickel	0·12
Copper	0·30

No sulphur was detected.

The specific gravity of the specimen analysed was found to be 7·836.

The preceding paper is a condensed report of a communication read before the Chemical Society.

REVIEWS.

A Practical Treatise on Cast and Wrought Iron Bridges and Girders, as applied to Railway Structures and to Buildings generally. By W. Humber, Assoc. Inst. C.E. E. and F. N. Spon, Bucklersbury.

We have waited until the third number of this work reached us before passing judgment on its merits; and we do not regret having withheld our notice, for we are now enabled to speak satisfactorily of the treatment the subject has, thus far, received at the hands of the author.

In the first number of an illustrated work, published in monthly parts, we always expect to find a good show of plates and illustrated matter; but it does not often occur that the quantitative and qualitative standards of the first are maintained in the following numbers.

In the present number, however, Mr. Humber does his subscribers ample justice.

In the first number Mr. Humber gives a litho.-tint perspective view of the Crumlin Viaduct. A double plate contains well selected details of the wrought-iron bridge over the river Stour, on the South Eastern Railway, and another plate of details of the Stamford Bridge Viaduct, on the East Riding Branch of the York and North Midland Railway.

In the second number there are a double Plate and two single Plates, illustrating the details of various railway bridges and viaducts,—viz., of the Vina Del Mar Bridge, of the Valparaiso and St. Jago Railway,—of the bridge over the Knottingley and Goole Canal, and of the Crumlin Viaduct.

The third number contains a double Plate of a skew-girder bridge on the Cannock Branch of the South Staffordshire Railway; a single Plate of details of the Sursuttee Bridge, on the East Indian Railway; and another single Plate containing some slight details of a swing-bridge erected at Bergin, in Norway.

Of the letterpress portion the quality improves with the progress of the work. Mr. Humber, in his Introduction, deals first with cast iron, and briefly explains the nature of the material, the process of its manufacture, and the uses to which it is applied. The proportions of section to load, and the various forms in use, and, by experience, found to be the best suited to the special purpose for which a girder or beam is intended, are discussed; and the question of the proportion of the breaking strength to the maximum load, and other points of interest, are also practically dealt with, and brought before the reader. Well selected citations from the Report of the Commissioners appointed by Parliament in 1849, upon Iron for Railway Structures, bring again before the practical engineer some valuable information upon the mixtures of metals recommended by various ironfounders; these are given in the second number, together with some practical formulæ for calculating the strength of beams, extracted from the works of Fairbairn and Eaton Hodgkinson.

Upon the subject of wrought iron constructions, Mr. Humber enters in his second and third numbers, and refers to the extensive series of experiments by Fairbairn, Hodgkinson, and Edwin Clarke. He describes the difference in the construction of tubular bridges, tubular girder bridges, the trellis girder of Warren and Kennard, the lattice bridge and other varieties of wrought-iron combinations, and then proceeds to describe the illustration given in the Plates before described.

The textual matter relating to the several works referred to is of a practical character, suited for reference, and at once available for the use of the constructive engineer.

The whole of the details referred to in the textual part of the third number relate solely to works executed by Fox, Henderson and Co., and designed and executed under Mr. Joseph Cubitt, C.E.

On the whole, Mr. Humber's work is, so far as it has progressed, a creditable performance, and, when finished according to his design, will form an excellent book of reference for the constructive engineer, and prove highly valuable to the profession generally. It has been got up in good style by the publishers; and the illustrations, generally, are alike creditable to the lithographic artist and the author.

We may hereafter refer to the work as it progresses towards completion.

LIST OF NEW BOOKS OR NEW EDITIONS OF BOOKS.

CAPLIN (J. J. E.)—The Electro-Chemical Bath, for the Extraction of Mercury, Lead, and other Poisonous Substances from the Human Body, in Palsy, Rheumatism, Scrofula, and other Complaints; and the Relation of Electricity to the Phenomena of Life, Health, and Disease. By J. J. E. Caplin. 12mo, pp. 128, sewed, 1s. (Freeman.)

DESIGNS and Examples of Cottages, Villas, and Country Houses, being the Studies of several eminent Architects and Builders; consisting of Plans, Elevations, and Perspective Views, with approximate Estimates of the Cost of each. Collected and edited by John Weale. 4to, with 67 engravings, cloth, 21s. (Weale.)

EXAMPLES for Builders, Carpenters, and Joiners; being well-selected Illustrations of recent Modern Art and Construction. Fifty copperplate engravings, with dimensions. Edited by John Weale. 4to, cloth, 21s. (Weale.)

NICHOLSON (P.)—The Carpenter's New Guide, or the Book of Lines for Carpenters Geometrically Explained; comprising all the Elementary Principles essential for acquiring a Knowledge of the Theory and Practice of Carpentry. New edition, founded on that of the late Peter Nicholson's standard work. Revised by Arthur Asphitel, with Practical Rules on Drawing. By George Pyne. 4to, cloth, 21s. (Weale.)

ARMSTRONG (R.)—The Modern Practice of Boiler Engineering; containing Observations on the construction of Steam Boilers, and upon Furnaces used for Smoke Prevention. With a Chapter on Explosions. By Robert Armstrong. Revised, with Notes and Introduction, by John Bourne, 12mo, pp. 203, cloth, 2s. (Spon.)

BUILDER'S AND CONTRACTOR'S PRICE BOOK; containing the latest Prices for Work in all branches of the Building Trade, with the items numbered for easy reference; and an Appendix of Tables, Notes, and Memoranda, arranged to afford detailed information commonly required in preparing Estimates, &c., for Contractors of Public Works; with an Almanack for 1857. 12mo, pp. 300, cloth, 3s. 6d. (Weale.)

CHEMISTRY (The) OF ARTIFICIAL LIGHT. Including the history of Wax, Tallow, and Sperm Candles, and the Manufacture of Gas, their various Illuminating Powers compared with Animal and Vegetable Oils; and a Descriptive Sketch of Lamps and other Apparatus. Post 8vo, pp. 140, cloth, 1s. 6d. Orr's Circle. (Houlston.)

GRIFFITHS (F. A.)—The Artillerist's Manual and British Soldier's Compendium. By Major F. A. Griffiths. 7th edit., 12mo, pp. 358, cloth, 7s. 6d. (Allan.)

CORRESPONDENCE.

THE SCREW-PROPELLER EXPERIMENTS ON THE "FLYING FISH."

To the Editor of The Artizan.

Sir,—The appearance of your paper on this subject at page 249 of your November part, has induced me to offer the following remarks, which I hope will find a place in your Journal.

It is stated in the paper that Mr. Griffiths tried a set of screw blades, constructed so as to incline at an angle of eighteen degrees towards the ship; and it appears that very good results were obtained from them, the inclined blades having a greater hold on the water and reducing the slip. I have for some time advocated the construction of screws with the outer portions of the blades inclined forwards, or in advance of the central parts; so that the most efficient part of the blade may act in solid water before it is disturbed by the central part, and I take Mr. Griffith's arrangement to be somewhat similar, as far as I can understand your description.

It would much increase the value of the paper if you could furnish a view of the improved blades. In Mr. Griffith's original specification he showed some propellers with the blades inclined forwards—but these were merely ordinary blades set at an angle—and I am afraid this has been the arrangement adopted in the case to which your paper refers.

If so, only part of the benefit to be derived from inclining the blade forwards will have been obtained, for if an ordinary blade is taken and set in the boss with a forward inclination, its acting surface will form an obtuse angle with the shaft, and this will undoubtedly give it a tendency to drive the water outwards. In the common arrangement of blade, the angle the acting surface makes with the shaft is a right angle, and for propelling a-head it would be better to make it an acute angle.

In inclining the blades forward, it is essential to shape the acting surface so that it shall still form a right, or acute angle, with the shaft; otherwise the benefit resulting from the most efficient parts of the blades working ahead, in solid undisturbed water, will be partly neutralised by the tendency of the inclined blades to throw the water outwards. If my supposition is right that Mr. Griffiths has not attended to this point, I feel certain, from the results obtained, that a much better result will yet be got by giving the blades the correct shape. An idea of this shape may be got by supposing an ordinary blade of twice or three times the ordinary length, as measured upon the shaft, to have the central part cut away at the front, and the outer part at the back.

It is stated in your Paper that at one trial there was a negative slip of three-quarters of a knot; and this almost convinces me that the blade was not of the proper shape, for this *apparent* negative slip evidently results from a miscalculation of the actual pitch; which miscalculation might occur if a common blade were used, and merely set at an angle in the boss, but could scarcely do so if the proper shape were retained.

Hoping this may elicit some further particulars respecting the experiments referred to,

I am, &c.,

Glasgow, November, 1856. Edmund Hunt.

THE UNPROFITABLE STATE OF SHIPBUILDING.

To the Editor of The Artizan.

Sir,—In your August and October numbers appeared two letters entitled—"The Causes and Remedy of the Unprofitable State of Shipbuilding." Whilst inserting those letters in your invaluable journal, you have unconsciously recorded an erroneous page in the history of "British Naval Architecture." At some future time, when a history of naval architecture may be written, these letters might be referred to as being a true statement of the state of British shipbuilding, which is not the case; therefore the errors in those letters ought to be pointed out.

Mr. Armstrong states that,—"The present practice in the construction of vessels has remained stationary for centuries." Now this is so self-evidently erroneous that it hardly requires any contradiction; but the fact of it being recorded in the Artizan, might at some future time cause a dispute not so easily decided. Every practical shipwright is well aware that a most complete revolution in shipbuilding has taken place this last few years. The vessels of the present day, it is a well-known fact, never before were equalled for speed, for strength of construction, and for beauty of form.

The unprofitable state of shipbuilding Mr. A. informs us, "arises from the uncontrollable demands of the workmen, and from the imperfect system in the management of the labour." The remedies he proposes may be summed up as follow:—

1. To form a large company for carrying on shipbuilding on an extensive scale. 2. To introduce a more scientific method of framing and planking vessels. 3. The introduction of machinery for sawing timber and plank; and planing machines for planing plank edges and decks; to have tram-roads and traversing cranes. 4. To destroy those combinations of workmen which exist, and make the workmen the willing slaves of the capitalist; to reduce the wages of the workmen to the lowest figure by a minute division of labour, similar to that adopted in our manufacturing districts.

1. Mr. A. says, "The system of framing adopted in shipbuilding demands the most serious consideration; and were it possible to point out a more absurd, erroneous, or barbarous method than at present practised, it would be necessary to go back to that period when mechanical construction and the application of materials for such purposes were in their infancy." If this were true, it were certainly a very great reproach to our shipbuilders, draughtsmen, inspectors, foremen, and the tens of thousands engaged in the construction of British vessels.

Less than a century ago, so inaccurate was the knowledge of framing vessels, that shipbuilders, generally, only made the frames to go the height of the wales, about two-thirds the height of the ship, and the frames were placed widely apart, often requiring a great deal taken off with the adze, for the ribbands. At that time ribbands and harpens were put up, and shored out and in to give the vessel its form, and timbers were hewn with the axe to fit to the ribbands and harpens. After the vessels were timbered, they often required a great deal taken off with the adze, both outside and inside to give the vessel its form, and make the timbers fair for plank. At this present time, so great is the improvement in shipbuilding, and so accurate the knowledge of the draughtsman, that the whole of a large ship's timbers are, generally, made into frames. The frames running the full height of the ship, and rough trees, poop timber, forecastle timbers, and timber heads, are often all put up with the frames; and so perfect and accurate is the framing of some ships, that they only require a chip taken off here and there to prepare them for planking, both inside and out, and that too with little or no trimming by the shipwright beforehand; the whole of the timbers being generally sawn. The keel, stem, apron, knightheads, sternpost, keelson, and beams are, in general, cut exactly to the required size, and not larger for trimming by the shipwright, as stated by Mr. A. The timbers are generally cut larger than required; for it is better to have them a little above the size than the least below it; for if below the size, they are liable to be condemned by the inspector; but it is rather an uncommon thing to see them "cut large enough for a ship 200 tons larger than the one required to be built."

Now, in framing a large ship, a platform is laid down on each side of the keel, nearly level with the top side of it. The timbers for framing are all sawn; and, where the saw-pits are alongside of the ship, the same cranes which lift the timbers on the pit to be sawn, will lift them from the pit when sawn on to the platform for the shipwright. The timbers being sawn, all the shipwright has to do to them is to try the mould on, see they are correctly sawn to the mould, try the bevels on according to the number or name of the frame and bevel; if they are not correct, they are then trimmed correctly. The frames of a ship, to prevent confusion in the construction, are divided into the fore body and the after body. The frames from the centre of the ship to the fore end being called the fore body, the others the after body; the centre frame being called dead flat, marked *. From this frame they are numbered on the one side and lettered on the other; the various stations, numbers and letters being marked on the side of the keel. The floors being laid across the keel in their various stations, on their sides, the timbers are then placed and fitted according to their marks, and bolted together. The timbers being bolted to the floor the whole are connected together; this being a much stronger construction than the old method, besides the floor being a great steadiment to the frame whilst canting it up into its station. The frame being made, the cross pauls put on to keep it the exact breadth, it is then canted up with the greatest ease, with two tackles, one on each side of the vessel; the tackles either being hung to a pair of shears, or two spars, one on each side of the ship, well gayed. The fall ends of each tackle being rove through leading blocks are then led to a winch, lines being made fast to the frame to steady it; it is then canted up.

The simplicity of this method of framing is only equalled by its utility. The advantages of having a long platform on each side of the keel for facilitating the progress of framing are numerous, and such as every practical shipwright can appreciate. Having the timbers for framing on the platform, near the stations of the frames ready for putting together, instead of lying in confusion about the yard, is a great advantage. When the frames are made and placed in their stations, according to the marks on the keel, then the platform is taken away to form the various stages around the ship. Now, had there been no platform, still staging would be required, and the cost of making the staging would be nearly equal to that of both platform and staging.

Mr. Armstrong proposes this method of framing:—"To have a permanent platform at the head of each vessel for the framing; and to transfer the body plan to the platform; to have the platform raised to suit the various sidings of the timbers; to have the moulds so perfect that the ends of the timbers might be cut off and dowelled by machinery in the saw-mill, only requiring to be bolted together; also to have all the holes bored through the timbers for the planks before they are made into frames. The process (that of framing) would be of such simplicity that mediocrity of talent would be all that would be required; with a traversing crane over the ship to lift the frames into their situations."

Now, these permanent platforms, after the frames were made, would only remain in the way, and occupy a great deal of space, which would otherwise be useful for placing materials to be used in the construction of the vessel. And the idea of lifting every frame from the head of the ship, is by no means a very bright one. If the frames were not strained out of form before they were placed into their stations, it would be a miracle. Transferring the body plan to the platform is of great utility in iron shipbuilding, where the moulding sides of the frame lie flat on the platform, and the frame is straight sideways; but, in wood shipbuilding, the moulding side of the timber does not lie on the platform, one mould being considered sufficient for the timbers of one frame, the two moulding sides of the timbers come together. Here, permit me to observe, is where Mr. A. says, "The system is theoretically wrong, because the timbers are not in that line they are laid off and trimmed for." True: but if four-fifths of the timbers are of one form, their variation will be nothing, and the variation of the rest, every three inches, so slight as to be not worth mentioning, and certainly not worth making extra moulds. Now, as the timbers are often not sided straight, they having to be converted to suit the piece they are cut out of, the raised platform would often require temporary pieces on it. In fact, if Mr. A.'s system of framing were adopted, it would require greater skill, and cost three times as much for labour.

Such harpens as Mr. A. speaks of have gone out of fashion long ago; and he thinks far wrong if he thinks he can save 75 per cent. by his method of harpening and ribbanding, or even 5 per cent.

Of planking outside and inside, Mr. A. says—"However painful the confession, a single alteration has not been made in the system for the last twenty-five years." Why, I am very little older, and certainly have not been at the trade all my life; but since I have been at it I have seen much improvement in the system of planking.

Having worked in many yards on the banks of the Wear, and even on the Thames, I have seen a variation in almost every yard. I leave practical shipbuilders to judge whether four-fifths of the planking made of one form by machinery, without the shipwright using either axe or adze, would fit timber and seam.

In planking, as well as in timbering, a great deal depends on the converter's skill and ingenuity; not in converting his timber and plank into one form, but into that form which is cheapest and best.

Now, I believe there is as minute a division of labour as is consistent with the progress and economy of shipbuilding. The division of labour is far minuter than Mr. A. seems to think; for, if he consider the various classes of workmen engaged in shipbuilding, with the various divisions of labour in each class or trade, he will find it of the most minute character. Shipwrights, joiners, sawyers, treenail makers, blacksmiths, forgemen, kneemakers, anchor-smiths, plumbers, fitters, founders, nailmakers, coppersmiths, painters, carvers and gilders, block and mast makers, are all engaged in shipbuilding; and many of those classes of workmen have a great deal higher wage than the shipwright, without being subject, like him, to lost time, through bad weather. On the banks of the Thames there is a minuter division of labour; but, from personal observation, I know this division impedes the progress of the work, and increases the cost. Division of labour, Mr. A. thinks, would reduce the wages. Experience proves this to be a fallacy, as regards shipbuilding; for, on the Thames, where a minute division of labour exists, the cost is greater than on the Wear, where it is not so minute, and further north, in Scotland, where it is still less, the cost for labour is less still.

Now, the grand object Mr. A. has in view, as regards the workman, seems to be to create a greater number of workmen than there is employment for, and, by the competition of the workmen themselves, reduce their wages. I will not assert, Mr. Editor, that Mr. A.'s proposal to deprive workmen of their individual liberty, and reduce their wages to a low figure, is the most infamous proposal a man can make; for I believe he has not seriously considered, and formally asked himself—what will be the social condition of the working classes if my proposals are carried into practical effect? Mr. A. seems to lament that, whilst all other classes of working men's wages are reduced, by science and machinery, that the shipwrights are not. Has he considered well that it is with his wages the working man has to live—has to support a wife and family—has to educate his children—to obtain tools to work with, books to increase his knowledge, and improve his mind, so as to make him a human being fit to live in civilised society? Has Mr. A. not read the terrible history of the workmen in our manufacturing and agricultural districts—the horrible social degradation existing there, enough to make a heart of stone lament for suffering humanity? And this is the work of low wages and long hours! If Mr. A. be a Londoner, let him take a walk through those dens of misery in Whitechapel, or read Mayhew's "London Labour and London Poor," before he again proposes to create a surplus number of workmen to reduce wages.

With respect, your obedient servant,

Deptford. J. H., Operative Shipwright.

TONNAGE REGISTRATION.—STEAM-SHIP CAPABILITY, &c.

To the Editor of The Artizan.

Sir,—Last month I endeavoured to show that no formula for ascertaining the dynamic efficiency of steam vessels could be satisfactory which had only the vessel's displacement, or the area of the immersed midship section, for its basis. And I ventured to suggest that, in conjunction with displacement, *length* should be taken as a datum; for without regarding displacement, which is absolutely the weight moved, there can be no dynamic measure at all: and without regarding length, it is impossible to calculate the resistance encountered by locomotion, because the longer any given mass of matter is, the smaller must be the resistance it encounters while passing through a fluid in the direction of its length.

Length and displacement are thus demonstrably two essential elements of the formula desiderated. In addition, we require velocity and power. What function of length may be appropriate, I have left for the present to the consideration of others. *Velocity*—while we are, as it were, evolving the primary elements of our formula, should be estimated in the ratio of its square; because its effect on actual resistance is in that ratio. And, to avoid confusion, we should, for the present, keep distinct what pertains to *resistance*, from what pertains to *power*. Then, having produced a clear expression of the value of resistance, it will be our business to ascertain from indicated H.P., velocity of vessel, and such other materials as may be necessary, what is the actual *modulus* of the propelling power; or, in other words, the equivalent of the resistance. Ultimately, after eliminating all that may be extraneous, we may produce a rule of a practical character, showing what power would be required to produce the velocity desired in any particular case. Of course, absolute exactness is not to be expected; it is impossible: still a formula of great value to all practically engaged in steam navigation, may be produced.

I should not now dilate further upon the subject, but await the effect produced on your more competent contributors and correspondents by my suggestion of last month, were it not for the remarkable confirmation of my views contained in your excellent current number, by the account of the Government experiment on the *Flying Fish*, and the somewhat astounding communication of Mr. Armstrong, which is also published in that number.

The experiment on the *Flying Fish* evinces the importance of length. A bow, 30 ft. long, no doubt of the most favourable lines, was added to her; and her speed, with the same screw, was increased one knot per hour. According to Mr. Atherton's formula, as her displacement was augmented, her velocity ought to have been diminished. And the midship-section theorists may perceive that a considerable expansion of that section might be made before the advantage produced would be counterbalanced, and then there would be a larger vessel, with increased midship section, propelled at the same velocity, in consequence of increased length by the same power.

Permit me to say that I am afraid Mr. Armstrong's last communication is calculated to bring this inquiry into discredit. He deprecates any legal compulsion—has no faith in the potency of the mandates of

"St. Stephen's" (few of us fill up the paper with our income-tax data without being at issue with him), and recommends that every steamer should furnish your office with a mass of information, whether compulsory or not he does not say, but *certes*—any circular sent to the steam-ship companies for such a purpose would, I fear, be considered impertinent, and treated accordingly. Mr. Armstrong has ingeniously quoted Mr. Murray's tables, and *supposed* facts to support his theory, but without success. It really is amusing to observe what an *ignis fatuus* a false theory is to an earnest inquirer after truth. He proves, with the aid of *conjectural* consumption of coals, *hypothetical* H.P., and imaginary immersed midship sections, that the *Himalaya*, a ship celebrated for her capabilities is, according to his "standard," six per cent. worse than the *Ajax*, an old seventy-four!

Mr. Armstrong chivalrously throws down the gauntlet; he says:—"I defy any one to point out a single established fact or principle in the whole range of the sciences of mechanics or hydrostatics that point to any other conclusion, but that the solid of least resistance is that body which presents the smallest section to the line of motion." There have been a great many experiments, from the celebrated academician experiments in France, to the minute ones of Mr. Bland. A great many vessels have been altered in this port with a view of producing speed. People have persisted in building floating bodies with tapering curved ends. And there is not a writer of any note from the time of Newton, Euler, and the older writers on the subject, to Lord Montagu and the most modern, who does not support in theory what common sense suggests and practical experience establishes; namely, that the body which presents the smallest section to the line of motion is *not* therefore the solid of least resistance, but that its minimum of resistance must result from its form.

Let Mr. Armstrong consult his Encyclopædia, or his Hutton—let him observe what is passing about him, and he will find that, from a first-rate screw steamer to a Minie rifle ball, there is nothing but conclusive evidence of the fallacy of the midship-section theory.

G. J. Y.

"THE ARITHMETIC OF STEAM-SHIP CAPABILITY."*

To the Editor of The Artizan.

SIR,—With reference to Mr. R. Armstrong's letter headed, "The Arithmetic of Naval Architecture," which appeared in THE ARTIZAN for the 1st October (No. 165), I observe that Mr. Armstrong disclaims the fundamental law that (*cæteris paribus*), "the power varies as the cube of the speed;" and assumes, as the base of his calculations, that (*cæteris paribus*) the power varies as the square of the speed; consequently, in applying his formula, Mr. Armstrong makes it appear by his tabular statement, that *Banshee*, at the draft of 9 ft., would be propelled at the speed of 18 miles per hour by 615 Indicated H.P.; whereas, the fact is, that on trial of *Banshee*, at 9 ft. draft, no less than 1,700 Indicated H.P. were actually exerted by the engines when driving the vessel at 18 miles per hour.

Again, Mr. Armstrong does not appear to have noticed that the displacement referred to in my calculations is the *mean* displacement (*see* "Steam-ship Capability," page 21)—that is, the displacement at the middle of the passage, when half the coals are consumed. By thus correcting his own misapprehension as to my specified data, Mr. Armstrong will find that there is no mistake in my calculation.

I cannot admit some of the assumed axioms which Mr. Armstrong has propounded, nor do I consider it necessary to discuss them, for I observe that Mr. Armstrong strenuously acknowledges the importance of bringing "Steam-ship Capability and Steam Transport Economy within the pale of arithmetical calculation;" and I have no doubt that Mr. Armstrong, in prosecuting this study, will soon find the necessity of adopting the fundamental laws on which only such arithmetic can be based, and that he will gradually acquire more distinct views as to the data best adapted for arithmetically comparing the capabilities of *dissimilar* vessels, than those in favour of which he appears to be at present impressed.

I remain, Sir,
Your very obedient servant,
CHAS. ATHERTON.

Woolwich Dockyard, 28*th October*, 1856.

[* Received oo late for insertion in our last.—ED.]

"THE ARITHMETIC OF STEAM-SHIP CAPABILITY."

To the Editor of The Artizan.

SIR,—Referring to the communications of your correspondents, G. J. Y., and Mr. R. Armstrong, in THE ARTIZAN for this month (November), No. 166, it appears to me that neither of these gentlemen have correctly apprehended the practical uses to which the application of the formula $\frac{V^3 D^{\frac{2}{3}}}{\text{Ind. H.P.}} = C$ is limited. It has never been assumed by me that the co-efficient (C) will be a *constant* number for vessels of dissimilar types of immersed form, and different adaptation of engines thereto; but, on the contrary, I affirm that, after having obtained, by the actual trial of a steamer of known displacement (D) the actual speed (V) corresponding to the actual working power (Ind. H.P.), and thence deduced the co-efficient (C) by the formula referred to, the resultant co-efficient (C) will be a constant number only for vessels of the particular type of form of the tested vessel, and equal engine efficiency in proportion to gross indicated power, whatever be their magnitude, as measured by displacement (D), or however their working power (Ind. H.P.) may be varied. The greater the resultant co-efficient (C), the greater is the dynamic duty of the ship in a purely mechanical point of view, not touching the sea properties of the ship; and consequently, on comparison of any two or more ships, the numeral co-efficients will indicate the order of constructive dynamic merits of the compared types, such dynamic merit being compounded of the type of form combined with engine efficiency; and in order to separate or discriminate between these two departments of construction, we must ascertain, by means of the dynamometer, the ratio of the net effective power to the gross indicated power; hence, in the case of a low co-efficient (C), we shall know whether the fault be mainly attributable to the ship or to the engines, or partly to both. Evidently, it may happen that a bad ship with good engines may produce the same co-efficient as a good ship with bad engines; but the merchant or shipowner, on thus detecting that something is wrong, will call in professional aid to detect the cause, and correct the fault. In the whole course of my experience I have never yet met with two vessels that gave identically the same co-efficient; it is quite common for the test co-efficients of vessels of ordinarily good newspaper repute, to vary as much as 40 per cent., which shows the necessity which exists, in a public point of view, for these matters being more generally and more systematically looked into. By examining into and adopting the types of those ships which may have been thus practically found to produce the highest coefficients of dynamic performance, the properties of steam-ships generally would then attain a higher range or scale of that dynamic merit on which the cost of goods transport and the efficiency of steamers for long voyages so materially depends.

As regards the questioned accuracy of the formula, I believe it to be substantially useful for practical purposes, though not *critically* correct. The *rationale* on which the formula is based, and my views concerning it, and also my views on the mercantile convenience that would result from deducing a co-efficient, based on the consumption of fuel per hour or other given time, instead of the engine power, have been pretty fully set forth in my papers read before the Society of Arts, London, and at the Cheltenham meeting of the British Association. I have also made these formulæ the base of a system of steam-ship arithmetic, as exemplified in my essay on "Steam-ship Capability," 2nd edition; an arithmetic which I believe to be original, and practically useful.

As regards the fundamental disagreement which exists between your correspondents and myself—viz., whether the propelling power varies (*cæteris paribus*) as the square of the velocity, or as the cube of the velocity; that is, for example, whether, in order to double the speed of a steam-ship, at a given draft, we must increase the propelling power four-fold or eight-fold, I decline further to argue the question; because it is, I believe, universally recognised by all received authorities, that the power varies (*cæteris paribus*) as the cube of the velocity, very nearly. Your correspondents' attempted explanation of their particular views do not, in my opinion, fully meet the scientific *rationale* of the question. I have no doubt that both these gentlemen, by continuing their useful labours—useful because, however erroneous, they bring the matter before the public, and induce thought—will very soon flounder into the right track; but, for the mean time, surely, such articles as those now referred to, based on the assumption that the propelling power varies (*cæteris paribus*) as the *square* of the speed, and appearing in THE ARTIZAN, is enough to arouse the now latent fire of "BOURNE."

I remain, Sir, your very obedient servant,
Woolwich Dockyard, 15*th November*, 1856. CHARLES ATHERTON.

ARTICULATED OR JOINTED VESSELS.

To the Editor of The Artizan.

SIR,—It having been surmised that jointed vessels would not answer the helm, I have assured Mr. Bourne that I never heard of any difficulty in steering those of Sir Samuel Bentham, and that had any existed, I must have known it. On the contrary, many instances were told me of his jointed vessels having steered amongst fallen trees, and avoided shoals, and other impediments in the Soje and the Dnieper.

It does not appear that his project of building sea-going jointed vessels was carried into execution; but the sad fate of the *Birkenhead* seems to indicate the expediency of thus constructing ships. This ship, though built of iron sufficiently strong, it was thought, to resist rocks, broke assunder in her first encounter with them, and was lost with the greater number of troops on board of her.

This would probably not have occurred had the vessel been jointed.

I am, Sir, yours truly,

26, *Wilton Place, Nov.* 18. M. S. Bentham.

NAVAL WARFARE—IN RELATION TO THE EMPLOYMENT OF INFERNAL MACHINES, OR SUBMARINE EXPLOSIVE SHELLS.

To the Editor of The Artizan.

Sir,—The attention now being bestowed upon engines of war, with a view to improve their destructive capabilities, would seem to indicate a state of disquietude, and an apprehension that peace will not be of long continuance.

In the event of another such struggle as that in which we were lately engaged with Russia, it is probable that, in the altered state of navigation and naval architecture, by the introduction of steam power to nautical purposes, together with various appliances at command, a mode of destruction, in naval warfare, will be brought into use, of which we should have a knowledge, and for which we should be prepared.

The mode of destruction alluded to, may shortly be brought to such a state of perfection, of which it admits, as to render cannon, in combat with it, of little avail. Our monster ships of war, of costly construction and equipments will, in such event, prove utterly useless either for the purpose of offence or defence.

It is to the employment of submarine mines, or explosive shells, in naval combat, we may look for the change contemplated. In the late war, the Russians had recourse to "infernal machines." The "infernal machine" is not altogether a novelty; the "torpedo" of Fulton, and the "invisible shell" of Warner were somewhat similar contrivances, both were for a like purpose, being intended to explode under the bottom of a vessel that may be the object of attack, with a view to bilge her to an extent to insure her sinking expeditiously.

The Russian contrivances which fell into our hands were so defective, both in engineering design and mechanical arrangement, that it is a matter of surprise that a people, reputed to be ingenious, should have essayed with engines so ineffective and ill-adapted to the purpose; unless intended as a decoy to lead their foes on to some of destructive efficacy. There is, however, reason to believe that the Russians have adopted "infernal machines" as a means of defence, which will consequently lead to their employment offensively; affording the Russians an immense advantage, if they, as apprehended, be in advance of other maritime states.

The object of this communication is, therefore, to show the practicability of the employment of one sort of submarine explosive shells in naval warfare, which will embrace a concise description of the mode of constructing, charging, and applying them; though by experimental results only, or actual combat, it should be observed, can their importance be manifested, affording an exhibition of their destructiveness. The information here intended to be imparted may, however, be a national good; since the submarine explosive shell is, at present, but little understood, or altogether misconceived, both by men in the profession of arms and the people. The sooner, therefore, this subject is thoroughly examined the better; for an immense amount of labour and mechanical skill have been, and are being wasted, which could be turned to profitable account by furnishing us with a means of defence and offence that may well suit our purpose at some future period.

But to proceed. The best form, perhaps, of the shell in question, both for defensive and offensive purposes is shown by the accompanying drawing (Fig. 1), which represents a longitudinal section of the shell; its

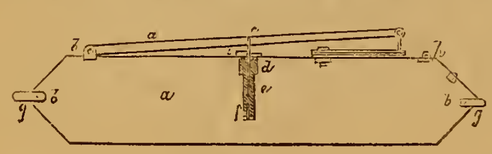


Fig. 1.

body, *a*, *a*, is of cylindrical form, the two ends, *b*, *b'*, are conical, *b* the head, *b'* the stern end of the shell; the shell may be made of stout sheet zinc; the size of the shell depending upon the nature of the explosive agent employed. When compactness is not absolutely necessary, a shell of 54 in., extreme length, having a cylindrical body of 36 in. length and 18 in. diameter, with conical ends of 9 in. length, would contain a charge of about 330 lbs. of large grain cannon powder; such charge, it is presumed would, when exploded 20 ft., or thereabout, below the surface of the water, and in contact with the bottom of a ship, of the scantling of the *Duke of Wellington*, of 131 guns, damage her so much as to preclude the possibility of keeping her afloat. The specific gravity of such a shell, with its exploding apparatus, would be a trifle greater than sea-water. If compactness of form be desirable, which it may be, under certain conditions, a smaller shell, of similar form to the one proposed, could be used; but the explosive material must be more violent than common gunpowder. The explosive material, whatever it may be, is poured into the shell, when required, through the charging plug of zinc, *c*, soldered on inside, the hole of which is secured water-tight by a screw; the shell, when charged, may be stored in the magazine as would be a barrel of gunpowder. To the cylindrical body is soldered on inside a plug of zinc, *d*, *d*, a substitute for a stuffing-box, and to which is soldered on a tube of zinc, *e*; the lower end of the tube is plugged with wood, into which is inserted a pin, *f*, of galvanised iron, of about 3 in. length and 1-8th in. diameter; this may be denominated the exploding pin. A hole of about ½ in. diameter, is bored through the plug of zinc, *d*, *d*, to allow of a bolt *f'*, of galvanised iron, which is denominated the exploding bolt, being worked, water-tight, in the plug. The lower end of the exploding bolt is bored out to the depth of 1 in. of circular form, of 3-8ths diameter; into this cavity is put, when the bolt is being prepared for action, a small glass bulb of sulphuric-acid; around the bulb is inserted also about 12 grains weight of a compound, consisting of chlorate of potassa, powdered, three parts (by weight); of sulphur, powdered, one part; and of refined sugar, powdered, one part; these three ingredients to be well blended; the bulb and compound are secured by tying a piece of paper over the end of the bolt. Upon the exploding bolt being pressed down upon the point of the exploding pin, the glass bulb will be crushed, the acid set free (which instantly explodes the compound around it), and so explode the powder with which the shell may be charged. The exploding bolt should fit so tightly in the plug as to require a pressure upon its head of about 30 lbs., to force it down.

To each end of the shell is rivetted and soldered on a ring or eye of galvanised iron, *g*, *g'*, to which are bent the tow lines (presently explained); there is also a smaller ring, *h*, secured, in like manner, to the shell, at the stern end of the body, to which is bent on the line of the buoy, to

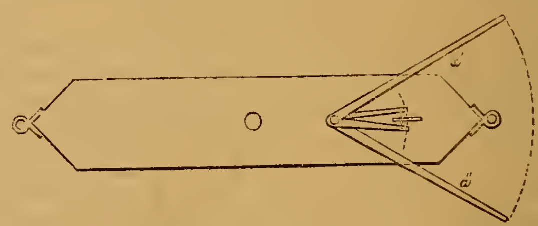


Fig. 2.

suspend the shell at any desired depth below the surface of the water. Upon the top of the shell is worked, in the head of the exploding bolt, the exploding lever, of galvanised iron, *a'''*; one end of the exploding lever is held by a hook, *b'''*; the other end is connected, by lines or wires, to two crank levers of galvanised iron, *a''*, *a''* (Fig. 2), so that, when the lever on either side of the shell is pressed upon by the shell being brought into contact with the bottom of the ship attacked, it pulls down the exploding lever, *a'''* (Fig. 1), which forces down the exploding bolt upon the exploding pin; the explosion, while the shell is in close contact, is so accomplished.

To the exploding bolt is fitted a safety key, *i*, which prevents the bolt, when inserted into the shell, from being pressed down upon the exploding pin, from the point of which it should be adjusted to be about three quarters of an inch. The safety key is fitted with a forelock (a piece of twine); the exploding bolt is not charged, nor inserted into the shell till it is about to be launched overboard for action; the forelock of twine is then cut away; tow lines bent, the shell may now be launched overboard, and veered some yards astern; the safety key is withdrawn by a line bent on to it. The safety key being withdrawn, the shell is in a state to be exploded by being brought into contact with any unyielding body, such as the bottom of a ship.

Having given some description of the shell, we may proceed to explain how it should be applied; and, with a view to simplicity, we will confine the explanation to a single steamer, the attacking vessel, and adapted to the service of the arm in question, and a single ship the object of attack, and one shell to be exploded; presuming that the attacking steamer can out-speed the ship attacked.

Suppose, then, the object of attack to be a ship on the starboard tack, to windward, and nearly within gun-shot distance. A shell is hoisted up from below, and placed on deck, close to the stern-post, upon its launch (the larger shells, of some three, four, or five hundred pounds' weight, when charged, should be each placed upon a launch, and in that state stowed in the magazine; shells of comparatively small dimensions and weight would not require to be so fitted with a launch); it should then be primed by pouring into the tube, *e*, *e* (Fig. 1), about an ounce of powder; then insert the exploding bolt, *f'*, charged and well greased, and put into gear the exploding lever, *a'''*, with the two crank levers, *a''*, *a''* (Fig. 2). As the shell, when charged, is a few pounds heavier than the water it displaces, it must be suspended at the desired depth below the surface of the water by a buoy: the buoy may be made of zinc, the size depending upon the weight it has to suspend. The depth at which the shell should be suspended must depend upon the draft of water of the ship attacked. This determined, bend on the buoy line, at the proper length, to the ring, *h* (Fig. 1), and launch the buoy overboard. The two tow lines should now be bent on to the ring, *g*, and lashed aftwards by a lashing through ring, *g'*, one on the starboard and the other on the port side of the shell. (The two tow lines are worked below deck, on each quarter of the steamer; the length of each tow line should be about 150 fathoms, and of suitable dimensions.) The forelock of the safety key may now be cut away, and the shell launched overboard and veered astern about 50 yards. It may be here remarked that the shell can be easily launched overboard from the stern-port by a very simple arrangement. Upon the steamer getting within gun-shot distance, the safety key should be withdrawn, and the shell veered about 150 yards astern. The steamer now shapes her course so as to pass about sixty yards ahead, letting go the starboard tow line, and holding fast the port tow line; by such means, the shell will make a broad sheer over to starboard, and when the steamer heads the ship, the port tow line comes obliquely across the fore-foot or cut-water of the ship; the shell, by the progress of the steamer, is brought into contact with the bottom of the ship somewhere, perhaps, in the port after-run. So soon as the shell is in close contact, the arm of the starboard crank lever, *a''* (Fig. 2), is pressed in towards the stern of the shell, the exploding bolt forced down upon the exploding pin, crushing the glass bulb of sulphuric acid, which, set free, instantly explodes the shell, and so bilging the ship to an extent to insure her immediate sinking. If, upon closing with the ship, it be deemed advisable to pass astern of her, then the port tow line must be let go, and the starboard tow line held fast; the shell, in such case, would make a broad sheer to port, and come in contact somewhere in the fore-body of the ship, the port crank lever exploding the shell. The shell, upon being towed, has a tendency to rise to the surface of the water; but being suspended by a line from its stern end, its head dips, and the tow line, being lashed aftwards, tends to increase the dip; so the shell will, when towed at the rate it is likely to be, keep at the desired depth below the surface of the water.

There is a variety of methods of applying the shells; to explain each method would be tedious; the one selected admits of easy explanation. We will remark only that, if the attacking vessel cannot take advantage of the darkness of night, or a fog, and not being adapted to the service, the shells may be turned adrift in pairs, with a buoyant span-line connecting them by their heads, a drag line being bent to the stern of one of the shells, so as to keep the span-line upon the stretch; a ship in her progress, taking hold of the span-line, by its coming across her fore-foot or cut-water, would bring one or both shells under her bottom, which would instantly explode upon being brought into close contact.

In the employment of shells defensively, there is also a variety of schemes; an explanation of them would far exceed the limits of the brief exposition intended in this communication; but it may be remarked, they admit of such application as to render a naval attack extremely hazardous, if not wholly impracticable.

Vessels adapted to the service of submarine explosive shells, should be of about five or six hundred tons, and be constructed with a view to the attainment of the greatest practicable speed. It can be shown that vessels of iron would be preferable to those of wood. They should be propelled upon the screw principle; the machinery should be protected as much as possible from the effect of shot. The fore part of the steamer, being the part exposed in her attacks, should be partitioned off at about 60 ft. from the stem; in the fore compartment so formed should be stowed, below the water-line, water-tight empty wooden cases; above these, and close up to the deck, should be compactly stowed some suitable resisting material, such as hemp, rendered incombustible. In the event of a shot or shell ripping open the vessel in the fore part, below the water line, her trim would not, in all probability, be altered, nor her speed impeded, by reason of there being no space unoccupied for the admission of water; her progress, therefore, would not be arrested. The crew, small in number, would be safe under deck; they would be berthed upon the kelson. The steering-wheel should also be under deck, the tiller ropes leading from above to below deck. The only person exposed would be the officer directing the steerage; but he can, to a great extent, be protected, his head only being just above the weather deck. There should be two decks: the main deck should be about 12 or 18 in. above the load water line; the upper, or weather deck, should be perfectly flush; no bulwark above it. The space between the two decks would afford accommodation for officers, crew, and provisions, also a quantity of coals, keeping the bunkers below the main deck always filled to protect machinery. In the stern, between the two decks, should be a port, through which, by a simple contrivance, the shells may be launched overboard.

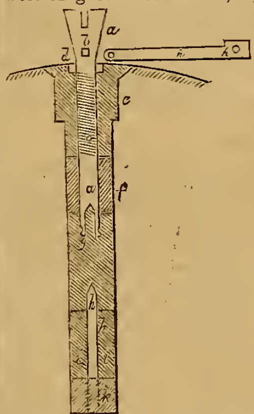
Under cover of the darkness of night the steamer would attack by choice; but the attack may be made in the light of day, by risking the topsides, which would most likely be more or less damaged should she be exposed to the broadside fire of a ship of the line. Such injury would not, however, disable the steamer; she could, with topsides damaged, pursue her work of destruction.

In conclusion, it may be stated, that the foregoing description of one sort of submarine explosive shell is warranted by a long and careful study of the subject.

Your obedient and obliged servant,

October 30*th*, 1856. J. H.

Description of (Fig. 3) a transverse section of shell, which shows the exact size of the exploding apparatus of the shell, the cylindrical body of which is 36 in. long, and diameter 18 in. *a*, *a'*, the exploding bolt of galvanised iron; *a*, the head, in the form of a crutch, in which the exploding lever *a'''* (Fig. 1) is placed when in gear; *b*, hole through the bolt to insert safety key, *h*; *c*, *c*, plug of zinc, substitute for a stuffing-box; *d*, *d*, a circular cavity, of about 1 in. diameter, and ½ in. deep, in which is pressed grease around the exploding bolt when it is inserted into the shell. The greater the pressure of the water, the more closely will the grease be pressed around the bolt, and so prevent leaking. The exploding bolt is served with twine: the parallel lines, *e*, *e*, respresent the twine service, by which the bolt can be adjusted to work in the zinc plug with any degree of tightness; *f*, *f*, pad of bibulous paper, pierced, to allow the bolt to descend; the pad is intended to absorb any moisture that might accidentally pass down between the bolt and plug; *g*, chamber in the lower end of exploding bolt, to contain bulb of sulphuric acid and explosive composition; *h*, the exploding pin; *i*, *i*, space for priming powder; *k*, *k*, plug of wood, into which the exploding pin is inserted (the plug closes the lower end of the tube); *h*, the safety key; *h''* the hole to receive the line by which the key is withdrawn when the shell shall have been veered to a safe distance astern; *h'''*, the hole to receive the forelock of twine. This is cut away just before the shell is launched overboard. The line by which the safety key is withdrawn leads through a wire loop in the fore part of the shell. *In order to prevent accidents, the exploding bolt should always be fitted with the safety key forelocked, and in that state stored.*



THE VIBRATORY MOTION IN FAST SAILING SHIPS.

To the Editor of The Artizan.

SIR,—It is well known that fast sailing ships are affected with a vibratory motion, very unpleasant to passengers and officers, when sailing at a high velocity.

Several ships have been cured of this in the following manner:—Let A, B, C, D be a horizontal section of the rudder. If a groove be cut up and down the back of the rudder, as at E, there will be no subsequent vibration. I have never known the experiment to fail. Can any of your scientific contributors give the *rationale* of this?

I am, Sir, your obedient servant,

Y.

THE STEERING APPARATUS OF THE "GENOVA."

To the Editor of The Artizan.

SIR,—I write to inform you of an error in your last month's ARTIZAN, in respect of the *Genova* being fitted with Mr. Sketon's patent Tiller, which was not the case, the *Genova* was fitted with Kidman's patent Steering Apparatus. The "Times" made the same error on the 22nd September, but contradicted it on the 21st October. I should be thankful if you correct the error in your next ARTIZAN.

Poplar, November 6, 1856.

[We readily insert this correction; at the same time we had the authority of the designer of the ship for making the statement.—ED.]

LIGHT DRAUGHT STEAMERS ON THE DANUBE.

To the Editor of The Artizan.

Sir,—Having been a subscriber to The Artizan ever since 1844, I beg to be permitted to correct an error in your August Number, p. 190, referring to the Imperial Royal Danube Steam Navigation Company.

The little steamer, *Tachtalia*, which draws only 14 in. of water, was not made in America, but in England, namely, at Messrs. John and Alfred Blyth's, Limehouse.

Length 150, beam 20, four paddle wheels, and two pair of horizontal direct acting engines of 40 horse nominal power. She goes exceedingly well against the immensely strong currents of the Iron Gate, Islas, and Greben, and is the admiration of every one that has seen her performances. I remain, Sir, your most obedient servant,

John Henry Heck,
Chief Engineer for the Lower Danube.

Turn Severin, October 20, 1856.

[The dimensions of the *Tachtalia* were given in our Number for August, 1855, p. 199. At page 190 of the August number of our present volume, there is not a direct allusion to this vessel by name, but merely a statement that the Company "possess a small, but very long steamer, drawing only 14 inches of water."—Ed.]

NOTES AND NOVELTIES.

Du Tremblay's Combined Ether and Steam Engine.—Burning of a French Steamer at Bahia.—"The screw steamer *La France* was built at Marseilles about two years ago, and was first employed in the transport of troops to the Crimea. Her hull and several of her main divisions were of iron; her tonnage was 2,200 tons, and the power of her steam and ether boilers and engines, 350 horses. She was fitted up with apparatus for the use of the vapour of ether as well as steam from coal, according to the system of M. Du Tremblay. It is stated that, by this plan, 15 tons only of coal and 60 litres of ether are required for the 350-horse engines for each 24 hours; whereas, if coal only were used, a consumption of nearly three times that weight would be necessary. It will be seen from this, that if the system can be safely adopted, it would prove a desideratum for long voyages. In the present instance, there is no doubt that the conflagration was originated by the want of care about the ether, as will be seen when I go into particulars. *La France* was the second vessel of the Marseilles line of steamers to the Brazils. She was on the outward voyage, and anchored in the Bay of Bahia on the 25th of September. She was preparing for her continued voyage to Rio de Janeiro on the 28th; but at about half-past ten o'clock on the night of the 27th, three men were engaged with lanterns in shifting luggage or cargo on the lower deck, when they smelt a strong odour of ether; and, thinking that some accident had taken place, two of them succeeded in extinguishing their lights, but the third in the attempt to do so upset his lamp, and set fire to some ether alleged to have been spilt upon the floor. One man was seriously burnt, the other two slightly. I could obtain no explanation of the reason why ether should have been in such an unsafe place. The ship was instantaneously in flames; guns were fired, bells were rung, the news was conveyed to Captain St. Brue, the commander of the ship, who was on shore with the consignees, arranging for the departure on the morrow. The local authorities of the city, the officers from the arsenals, and from the vessels in port, hastened to afford all the assistance in their power; the passengers and their baggage were got safely ashore, and, about three o'clock in the morning the fire seemed to be entirely put out, and the captain dismissed the assistance given to him. Notwithstanding this confidence, the flames again broke out with fury, and this time there was not the means of subduing them. It was found impossible to save the ship; and, owing to the fear of explosion of the ether, which was known to be in cisterns on board, it was found impossible to get lighters to go alongside to take away the cargo, or to make the tugboat available to tow the blazing ship into shallow water. It was determined, therefore, to sink her where she lay; and, about ten in the morning, the plugs in the ship's bottom were drawn out, and the vessel sunk, leaving her chimney and awning stancheons above the water level. Just before the *Avon* passed through Bahia, the hull of the sunken vessel and its contents had been offered by public auction, and sold for about £5,000. Attempts are intended to be made immediately for the raising of the vessel, her machinery, and the cargo; and the purchaser is sanguine of being able to realise a large sum by the transaction. The vessel was insured for a sum of about £50,000. I avail myself of the opportunity of giving the following brief description of the system of Du Tremblay, which I was favoured with by an engineering friend:—The engine for working by the vapour of ether, invented by Du Tremblay some three years ago, consists of a large working cylinder, with piston as usual, but having an outer casing, or, as we should call it, a steam jacket, into which the used steam is discharged from the cylinder. This contains a number of tubular chambers of an oblong section, say about 1½ in. by ½ in. in area. These tubes may be considered as constituting the ether boiler, as they contain that liquid; and, being surrounded by the steam, vapour of ether is generated at such a pressure as to be available for working a piston and machinery, much in the same way as in the steam-engine."—*Manchester Guardian.*

Samuelson's Screw Propellers.—Mr. M. Samuelson, of Hull, proposes to make an open space through the blade close up to the boss in such manner that each propelling blade is connected, by two arms at a distance from each other, to its nave or boss, in place of mounting each blade of a propeller on a single arm, as has in some cases before been done.

A New Calculating Machine.—The French *Moniteur* contains the following paragraph:—"M. Thomas, of Colmar, has lately made the finishing improvements in the calculating machine, called the arithmometer, at which he has been working for upwards of thirty years. Pascal and Leibnitz, in the 17th century, and Diderot at a later period, endeavoured to construct a machine which might serve as a substitute for human intelligence in the combination of figures, but their efforts failed. M. Thomas's arithmometer may be used without the least trouble or possibility of error, not only for addition, subtraction, multiplication, and division, but also for much more complex operations, such as the extraction of the square root, involution, the resolution of triangles, &c. A multiplication of eight figures by eight others is made in eighteen seconds; a division of sixteen figures by eight figures in twenty-four seconds; and in one minute and a quarter one can extract the square root of sixteen figures, and also prove the accuracy of the calculation. The arithmometer adapts itself to every sort of combination. As an instance of the wonderful extent of its powers, we may state that it can furnish in a few seconds products amounting to 999,999,999,999,999,999,999,999,999,999. A marvellous number, comparable to the infinite multitude of stars which stud the firmament, or the particles of dust which float in the atmosphere. The working of this instrument is, however, most simple. To raise or lower a nut screw, to turn a winch a few times, and, by means of a button, to slide off a metal plate from left to right, or from right to left, is the whole secret. Instead of simply re-producing the operations of man's intelligence, the arithmometer relieves that intelligence from the necessity of making the operations. Instead of repeating responses dictated to it, this instrument instantaneously dictates the proper answer to the man who asks it a question. It is not matter producing material effects, but matter which thinks, reflects, reasons, calculates, and executes all the most difficult and complicated arithmetical operations, with a rapidity and infallibility which defies all the calculators in the world. The arithmometer is moreover a simple instrument, of very little volume, and easily portable. It is already used in many great financial establishments, where considerable economy is realised by its employment. It will soon be considered as indispensable, and be as generally used as a clock, which was formerly only to be seen in palaces, and is now in every cottage. Generally speaking, the practical application of any great mechanical improvement involves an injury to certain interests; but that is not the case here. The arithmometer will not cause to the persons employed in banks, counting-houses, and public offices any such prejudice as the knitters suffered from the invention of the stocking frame, the spinners from the spinning jennies, or copyists from the invention of printing. The person who makes use of this machine even daily does not therefore lose his aptitude for calculation in the ordinary way. On the contrary, although a child may be easily taught to perform the most complicated calculations by the use of the instrument, the more expert in figures the operator is the more advantage he will derive from the aid of this machine. The arithmometer is not only a palpable evidence of a great difficulty overcome, it is an element of wealth, a new means of multiplying time, like the locomotive engine and the electric telegraph. The discovery is an event the full importance of which it is impossible as yet to measure."

Jarrow Docks.—The foundation stone of the principal entrance to the Jarrow Docks was lately laid by Mr. T. E. Harrison, C.E. These important works, which are in the course of construction by the North Eastern Railway Company, are in a large bight at the end of Shields harbour, on the Durham side, and are about two miles from the sea. There will be forty-eight acres of water in the principal basin, which will have two entrances, one sixty feet wide, with an entrance lock, capable of holding fifteen or sixteen vessels; the other 80 ft. wide, which will admit large paddle-wheeled steamers into the dock. There will be sixteen berths for shipping coals, with room for eight more, and a large space will be occupied with quays and warehouses. There will be twenty-three miles of standage for waggons, and the docks, through the instrumentality of steam and sailing vessels, will connect the North Eastern Railway with all the great coal importing countries in the world. The total acreage will be 140. Mr. Gow's contracts are for £230,000.

Scinde Railway.—An addition of three engineers to the staff of the Scinde Railway Company sailed on the 20 ult., by the Peninsular and Oriental Company's steamer for Bombay, *en route* Kurrachee. This is the fourth mission despatched last month to the East by the companies of which Mr. Andrew is chairman—viz., on the 2nd, General Chesney, Sir John Macneil, and a staff of engineers to Constantinople and Syria. On the 4th, Mr. Brunton and six engineers to the Punjaub. On the 10th, Mr. F. Horsley Robinson, with M. Musalli, as secretary and interpreter, to Constantinople, to conclude arrangements for the telegraph between England and India.

American Merchant Ships.—The *Great Republic*, the largest ship ever built in our country for the commercial marine, by Donald M'Kay, of Boston, was burned to the water's edge during a great fire in this city in the winter of 1853, when loaded and ready for sea on her first trip. Her hull was saved, however, and sold by auction; she was rigged anew and sent to Europe, where she was employed by the French Government as a store ship during the Crimean war, in which service she surpassed all others for her sailing qualities and great capacity, having carried 3,000 soldiers and 400 horses during the trip, besides heavy cannon and ammunition. Having completed her engagements with the French government, she arrived at this port last week, and was the object of much attention.—On the 15th ult. a new and magnificent Liverpool packet-ship, the *Ocean Monarch*, was successfully launched from the foot of Tenth-street, East River, in the presence of an assemblage of 5,000 persons. Her length is 240 ft. on deck, breadth 46 ft., depth of hold 30 ft. She can carry 7,000 bales of cotton. Her frame is of live and white oak, and she is bound from stem to stern with angle-crossed iron straps 4½ in. by ¾ in. She is not only the largest but the strongest merchant ship ever built in New York. A great change has taken place in the form and character of our merchant ships during the past six years. In appearance they are entirely different from the old ships; they are larger, sharper, and more graceful in their proportions.

LIST OF NEW PATENTS AND DESIGNS FOR ARTICLES OF UTILITY.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

Dated 15th July, 1856.
1664. A. Neild, Manchester—Jacquard and other looms. (A communication.)
Dated 1st August, 1856.
1822. J. Avery, 32, Essex-st., Strand—Bonnets, &c. (A communication.)
Dated 6th August, 1856.
1858. J. Braby, Borough Haymarket, Newington Causeway—Sawing machinery.
Dated 26th August, 1856.
1992. A. V. Newton, 66, Chancery-la. — Breech-loading cannons.
Dated 3rd September, 1856.
2041. J. B. M. Jobard, Bruxelles—Lamps.
Dated 6th September, 1856.
2076. S. W. Park and E. S. Ells, Troy, New York, U.S.—Machinery for knitting tubular ribbed fabrics.
Dated 15th September, 1856.
2152. F. Moreau, 39, Rue de l'Echiquier, Paris — Tops of omnibuses and other carriages.
Dated 17th September, 1856.
2178. A. L. Newman, New Church-st., Bermondsey — Separating animal from vegetable fibre.
Dated 19th September, 1856.
2199. A. Hustler, Bradford—Looms for weaving.
Dated 27th September, 1856.
2265. D. Law and J. Inglis, Glasgow—Moulding or shaping metals.
Dated 24th September, 1856.
2234. A. J. B. Lespinasse, Toulouse—Obtaining motive power.
Dated 25th September, 1856.
2246. H. J. M. E. Silvy and A. A. H. Plagniol, Paris—Improvements in harness.
Dated 27th September, 1856.
2261. J. Holland and J. Irving, Manchester—Treatment of waste woollen yarns, whereby the fibre is rendered capable of being again spun and manufactured.
2263. G. Neall, Northampton—Union gas stove.
2267. F. Ransome, Ipswich—Artificial stone.
2269. J. Edwards, Liverpool—Ships' log.
2271. J. Ormerod, Salford—Machinery for bleaching and washing textile fabrics.
Dated 29th September, 1856.
2273. J. F. Victor Larnaudès, 2, Rue Gabrielle, Montmartre, near Paris—An anti-putrefactive and disinfectant.
2275. J. N. Ward, United States—Self-priming fire-arms.
2277. M. Hickson, Salford—Waterproofing woven fabries
2279. R. Morrison, Newcastle-upon-Tyne—Apparatus for lifting, lowering, hauling, and removing moveable articles by the direct action of either water, steam, or gaseous vapour.
2283. C. W. Ramié, Pimlico—Permanent ways of railways.
Dated 30th September, 1856.
2285. T. A. Dillon, Registry of Deeds Office, and John Gray, M.D., 4 and 5, Princes-st., Dublin—An improved means for making signals on railway trains between the guard and driver respectively, and between the passengers and guard and driver, and of giving notice to the guard and driver in case of the accidental severance of the parts of a train, which invention is applicable also to steam-ships, factories, and other places where it may be requisite to communicate with distant points.
2287. S. Jay and G. Smith, 246, Regent-st.—Material for bonnets, hoods, hats or caps.
2289. D. Bruce, Paspebiac, Canada—Concentrated animal manure.
Dated 1st October, 1856.
2290. P. A. le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Voltaic battery.
2291. C. L. H. Quentin, 27, Rue des Petits Hotels, Paris—Artificial millstones.
2292. G. Flint, Skinner-st., Bishopsgate, T. and E. Wood, Tachbrook-st., Pimlico—Punching press for stamping, coining, slotting, and embossing, and cutting metal and other substances.
2293. J. Dauglish, Great Malvern—Making bread.
2294. J. Holman, Western Clubs, Topsham—Ships' rudders.
2295. J. Begg, Glasgow—Preparing and bleaching textile fabrics.
2296. H. Naylor, Bacup, Warper, and J. Crabtree, Rochdale—Warping mills.
2297. J. Paterson, Linlithgow, N.B.—Paper.
2298. A. V. Newton, 66, Chancery-la.—Sewing machinery.
2299. R. G. Salter, Alphington, Devon — Apparatus for stamping or marking of letters, &c.
2300. C. D. Gardissal, 10, Bedford-st., Strand—Stoves and apparatus for heating or warming.
2301. C. D. Gardissal, 10, Bedford-st., Strand—Pump.
2302. D. Jones, Greenhill-villa, Ragland, Monmouthshire—Obtaining and applying motive power.
2303. E. Wilcox, Harmston, Lincolnshire—Pumps.
Dated 2nd October, 1856.
2305. E. Hardon and J. Henry, Stockport—Looms for weaving.
2306. J. Whitehead, Dukinfield, Cheshire—Machinery for preparing and spinning cotton, &c.
2307. J. Renshaw, Salford—Machinery for cutting or producing the pile of plain or figured velvets, &c.
2308. V. Renault, Bordeaux—Regulating and directing the steam escaping from the cylinders of locomotive engines.
2309. D. Desmond, Upper Thames-st.—Vessels for storing and discharging liquids.
2310. H. J. Distin, 31, Cranbourne-st., Leicester-sq.—Regulating the tone of kettle drums.
2311. R. Edmeston, Bradford—Looms for weaving.
2312. C. Goodyear, Leicester-sq.—Securing the openings of air-tight and other bags and packages.
2313. M. T. Crofton, Leeds—Indicating and registering the number of persons entering a public vehicle.
Dated 3rd October, 1856.
2314. J. Hopkins, 5, Lower Oxford-st., Whitechapel—Furnaces.
2315. P. A. le Comte de Fontainemoreau, 4, South-st., Finsbury—Roofs of buildings and arches of bridges.
2316. J. Hall, jun., Mount Pleasant, Walmersley, near Bury, Lancashire—Improvements in looms.
2317. W. Johnson, 47, Lincoln's-inn-fields—Manufacture of sheet caoutchouc, and the combination thereof with cloth and other fabrics.
2318. L. W. Wright, Sydendam—Gas meters.
2319. G. F. Wilson and A. I. Austen, Belmont, Vauxhall—Soap.
2320. D. O. Boyd, 78, Welbeck-st.—Smoke and air flues.
2321. B. P. Mosqueron, Widow Vilcoq, Paris—Lamp oil.
2322. R. A. Brooman, 166, Fleet-st.—Improved lathe or tool.
2323. J. Allen, Castle-pl., Castle-st., Canterbury—Coats.
2324. R. and J. Haslam, Preston, Lancashire—Looms for weaving.
2325. C. Farquharson and W. Grimshaw, Mitcham—Apparatus for indicating and regulating the pressure of steam in boilers.
2326. C. D. Gardissal, 10, Bedford-st., Strand—Manufacture of cement.
Dated 4th October, 1856.
2327. A. Picard, 39, Rue de l'Echiquier, Paris—Tobacco pipe.
2328. A. V. Newton, 66, Chancery-la.—Supplying steam-boilers with water.
2329. W. Preston, Over Darwen, Lancashire—Machinery for the manufacture of paper-hangings.
2330. Maria Farina, Hanway-st., Oxford-st.—Tooth powder. (A communication.)
2331. J. Butteley, Liverpool—Iron for knees for ships, &c.
Dated 6th October, 1856.
2332. J. Silvester, Woolwich—Application of steam or air in the production of motive power.
2333. J. Gedge, 4, Wellington-st. South, Strand—Preparation of rocky substances for obtaining mineral manure.
2334. H. Mackworth, Clifton—Separation and treatment of mineral substances, and in coking, and in apparatus connected therewith.
2335. A. Dunlop, Glasgow—Dressing flour.
2336. V. Avril, Paris—Manufacture of iron and steel.
2337. V. Avril, Paris—Manufacture of iron and steel, and in the construction of furnaces to be employed therein, also in the obtaining of a certain agent employed in such manufacture.
Dated 7th October, 1856.
2338. R. Hazard, 1, Thanet-pl., Strand—An improved apparatus for intercepting the smoke and heated gases in its passage from boilers, stoves, furnaces, and kilns, to the chimney, and thereby extracting a portion of its heat, which is made available for drying and warming purposes.
2339. T. B. Smith, Taunton, Massachusetts—Permanent way of railways, and the running of railway carriages.
2340. O. W. Barratt, Birmingham—Dyeing and ornamenting of articles of pearl, bone, and vegetable ivory.
2341. W. N. Parsson, Southwark-bridge-rd.—Rotary sawing machine.
2342. S. Bottomley, Bradford, and J. W. Crossley, Brighouse, York—Pile or nap fabrics.
2343. J. Hinks, Birmingham—Metal boxes.
2344. W. Wilkinson, Nottingham—Castors in the legs of tables, chairs, pianofortes, &c., and in apparatus for perforating castor wheels, which is also applicable to the perforating of glass articles generally.
2345. W. Wilkinson, Nottingham—Ornamenting glass.
2346. J. Bunnett, Deptford—Metal sash-bars, columns, and mouldings, and protecting them from oxydation.
2347. J. A. Le Franc, Cecil-st., Strand—Lubricating oil cans.
2348. G. F. Wilson, Belmont, Vauxhall—Rosin oil.
2349. W. Marriott and D. Sugden, Huddersfield—Purifying coal gas.
Dated 8th October, 1856.
2350. W. Ward, Warrington—Woven fabric.
2351. J. Chiosso, Camden-town—Damping and affixing adhesive stamps and labels.
2352. F. Whitehead, Crayford, Kent—Apparatus for producing devices in or on wood, leather, and other substances.
2353. E. A. Pontifex, Shoe-lane, and G. H. Ogston, Greenwich—Manufacture of tartaric and citric acids.
2354. W. Bradford, Manchester—Gas burners for lighting and ventilating.
2355. J. Leigh, Manchester—The use of a certain substance in the manufacture of paper for stiffening and sizing the same.
2356. D. Foxwell, Manchester—Consuming smoke and economising fuel.
2357. T. Dugdale, jun., Blackburn, Lancashire—Lubricator.
2359. P. Ward, Liverpool — Composition for coating the bottoms of ships.
2360. H. Watson and J. Dixon, High Bridge Works, Newcastle-on-Tyne—Cocks and valves.
2361. C. Iles, Birmingham—Frames and stands, and in suspendors, or pegs for hats, coats, &c.
2362. F. Julien, 4, Trafalgar-sq.—Ordnance or cannon.
Dated 9th October, 1856.
2363. W. S. Clark, High Holborn—Churns for butter.
2364. T. King, Spitalfields—Continuous compressing machine.
2365. J. A. Longridge, Fludyer-st., Westminster, and T. Richardson, Newcastle-upon-Tyne—Fire boxes of locomotive steam boilers.
2366. G. H. Cottam and H. R. Cottam, St. Pancras Iron Works, Old St. Pancras-rd.—Iron hurdles.
2367. C. Burton, Regent-st.—Machinery for washing fabrics and clothes.
2368. W. Nairne, Aberdalgie, near Perth—Machinery for preparing flax, tow, &c.
2369. J. B. Howell, Sheffield—Manufacture of cast-steel.
2370. J. Shaw and E. Shaw, Glossop, Derby—Pianofortes, organs, harmoniums, &c.
2371. L. J. Jordan, Berners-st.—Medicine for venereal affections.
2372. J. S. Hendy, Essex-st., Strand—Stoves or grates for domestic purposes.
Dated 10th October, 1856.
2373. J. A. Labat, jun., Bordeaux—Stoppering bottles, jars, &c.
2375. C. R. N. Palmer, Southampton—A signalizing apparatus for carriages, and improved telegraph or signal apparatus.
Dated 10th October, 1856.
2376. W. Johnson, 47, Lincoln's-inn-fields—Railway brakes.
2377. W. Johnson, 47, Lincoln's-inn-fields — Fulminating powder.
2378. P. A. Gatty, Accrington—Dyeing.
2379. J. McInnes, Liverpool—Surface mineral coating for protecting iron and other substances, and a varnish by which it is applied.
2380. W. Rennie, jun., Lagan Foundry, Belfast—Condensing apparatus of steam-engines.
2381. R. McConnell and A. Mackenzie, Glasgow—Supplying steam boilers with water.
Dated 11th October, 1856.
2383. W. H. Ashburn and J. Fairhurst, Blackburn—Machinery used in the preparation of fibrous substances for spinning.
2384. W. C. Watson, New York—Sewing machines.
2385. A. B. Seithen, 12, Alpha-pl., Caledonian-rd.—Machinery for cutting cork.
2386. G. Heppell, Uttoxeter, Stafford—Ventilating mines.
2387. J. Latham, Liverpool—Registering the number of passengers by omnibuses, &c.
2388. A. V. Newton, 66, Chancery-la.—Gaseous liquid for generating motive power.
2389. G. W. Varnell, Royal Veterinary College, Camden-tn.—Mounting troughs, mangers, and apparatus used for feeding horses, &c.
2390. G. Scheurmann, Newgate-st.—Printing music when type is employed.
2391. L. Ador, and E. Abbadie, Paris—Manufacture of colours from metals, and the furnaces for the same.
Dated 13th October, 1856.
2392. G. Elliott, Newcastle-upon-Tyne—Production of oxides of manganese.
2393. C. S. Johns, Barnard's-inn, Holborn—Machinery for preparing pulp for the manufacture of paper.
2394. W. and J. Todd, Heywood, Lancaster—Power looms for weaving.
2395. B. Kisch, Kennington—An apparatus for containing an arrangement of cards or papers for selection.
2396. C. E. Mony, Paris—Transmitting motive power.
2397. G. B. Piatti, Genoa—Production of ice.
2398. J. Roscow, Radcliff, Lancaster—Machinery for cutting or rasping dye woods.
2399. J. Stephen, Glasgow—Steam boilers and furnaces.
Dated 14th October, 1856.
2400. R. Sumner, Droylesden, Lancaster—Power looms for weaving.
2402. S. Bremner, Newcastle-upon-Tyne—Pouches or envelopes, and machinery for manufacturing the same.
2403. R. A. Brooman, 166, Fleet-st.—Method of, and composition for, splitting or rending rock, stone, and earth.
2404. T. S. Cressey, High-st., Homerton—Machinery for cutting, hollowing, and backing staves.
2405. T. Allen, Clifton—Metallic bedsteads.
Dated 15th October, 1856.
2408 E. Hallen, Cornwall-rd., Lambeth—Chairs, sofas, bedsteads.
2409. J. Burrows, Wigan, Lancashire—Apparatus employed in winding coals.
2410. B. J. Heywood, Hawley-rd., Camden-tn.—Valves for inflating air-tight bags, cushions, and for drawing off liquids.
2411. A. and L. Turner, Leicester—Elastic fabrics.

2412. J. Palmer, Stockton-on-Tees, Durham—Machinery for separating different kinds or qualities of seed and grain.

2413. G. Hazeldine, Lant-st., Southwark—Carriages requiring 'poles' between the horses.

Dated 16th October, 1856.

2414. G. Collier, Halifax—Piled fabrics.

2415. A. Tooth, 14, Mincing-lane—Process for bleaching malt, whereby the colour is rendered more suitable for the brewing of pale or bright malt liquors.

2416. C. J. L. Leffler, Old Broad-st.—Casting of metals.

2417. R. F. Sturges, Birmingham—Cylinders for printing fabrics.

Dated 17th October, 1856.

2418. C. N. Wilcox, Islington—Toilette soaps, pomades, &c.

2419. E. Tombs, Islington—Screw propelling.

2420. J. Commandeur, Lyons—A mechanical apparatus for regenerating the impulsive force of any motive power.

2421. F. Foggi, 24, Southampton-pl., New-rd. — Engines driven by steam or other vapour.

2422. J. Green, 27, Charlotte-st., Portland-pl., Marylebone—Cooking apparatus.

2423. E. Rogers, Abercarn, Monmouthshire—Apparatus for combustion of fuel.

2424. J. E. Reed, Southgate, Middlesex—Mixture for the cure of asthma, and affections of the chest or lungs.

2425. P. A. le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Turbines.

2426. P. A. le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Brandies and alcholic products.

2427. W. Dray, Swan-la.—Apparatus for the stacking or storing of corn, &c.

2428. G. Wilson, Glasgow—Power looms.

2429. W. Jeffrey, Glasgow, N.B.—Machinery for sawing or cutting wood.

2430. J. McDowall, Johnstone, Renfrewshire—Sawing or cutting wood.

2431. N. Brécheux, Paris — Looking-glasses for dressing rooms, &c.

2432. G. Morton, Keighly, Yorkshire — Escapements for chronometers.

2433. T. F. Henley, Bromley—The employment of certain substances not hitherto made use of, for the production of alcoholic spirits, and for the manufacturing of the same, the refuse material being applicable as a food for cattle.

2434. A. V. Newton, 66, Chancery-la.—Tufted pile fabrics.

2435. W. Gossage, Widness, Lancashire—Coal-gas for illuminating purposes.

2436. J. Smith, Kirtley, Suffolk—Heating the feed-water of steam boilers.

2437. S. C. Lister and W. Tongue, Bradford, Yorkshire—Spinning.

2438. J. R. France, Clarence-st., Islington—Electric telegraph apparatus.

2439. F. A. Magnay, Taverham Mills, nr. Norwich, and R. R. Whitehead, Royal George Mills, Saddleworth—Damping paper for printing.

2440. W. Palmer, jun., Sutton-st., Clerkenwell—Roof candle-lamps for railway and other carriages.

2441. T. Lawes, 32, City-rd.—Agricultural implement to be used in tilling the land.

Dated 18th October, 1856.

2442. R. H. Collyer, M.D., 3, Park-rd., Regent's-pk.—Manufacturing paper.

2443. L. J. P. de Mirimonde, Paris—Reducing the friction of axles and axletrees of carriages on railways.

2444. I. Delcambre, Paris—Machines for composing and distributing type.

2445. J. George, 39, Rue de l'Echiquier, Paris—Crane.

2446. J. F. Deshayes, Paris—Machinery for dyeing silk, cotton, or woven fabrics.

2447. H. Brown, Halifax—An improvement in spinning worsted.

2448. T. Flockton, 4, Trafalgar-sq., Charing-cross — Consumption of smoke.

2449. C. Humfrey, 14, The Terrace, Camberwell—Grease for lubricating railway and other machinery.

Dated 20th October, 1856.

2450. J. Harrison, Blackburn, Lancashire—Machinery for warping yarns.

2451. Sir F. C. Knowles, Bart., Lower Hill, Berkshire—Manufacture of iron and steel, and in the preparation of fuel used therein.

2452. R. A. Brooman, 166, Fleet-st.—Farthingales or petticoats.

2453. L. P. Huteau, 39, Rue de l'Echiquier, Paris—Petticoat.

2454. J. Young, South Shields, Durham—Ventilator.

2455. R. G. Barrow, 15, Wade-st., Poplar—A self-maintaining motive power.

2456. J. Lacassagne and R. Thiers, Lyons—Electric lamp.

2457. J. T. Forster, Wandsworth-rd., Surrey—Symbols used in signalling.

2458. J. G. Jennings, Holland-st., Blackfriars—Wall caps, sleeper blocks for the basements of buildings, and bricks to be used as substitutes for wood bricks in building.

2459. C. R. Freeman, Eaton, Norwich, and W. D. Key, Norwich—Manufacturing food for animals.

2460. A. Lorimer, Bedford-sq. E., Commercial-rd.—Reworking vulcanized india rubber.

2461. W. Parsons, Pratt-st., Lambeth—Generating and employing steam in steam engines.

2462. H. Deacon, Hans-pl., Chelsea—Suspending carriage bodies.

2463. W. Clay, Liverpool, and J. Harris, Dolgelly, Merionethshire—Manufacture of iron and steel.

Dated 21st October, 1856.

2464. C. Briqueler fils, 22 Rue Emery, Dunkerque—Purification, clarification, and discolouration of the cotton seed oil.

2465. H. Thompson, Great Harwood, nr. Blackburn, Lancashire, and T. Curtis, Blackburn—Manufacture of healds or heddles.

2466. J. C. Martin, Fern cottage, Charlewood-rd., Putney—Glazing paper.

2467. G. Blair, Leicester—Looped fabrics.

2468. P. A. le Comte de Fontainemoreau, 39, Rue de l'Echiquier, Paris—Knitting-loom.

2469. S. Smith, Soho—Furnaces.

2470. W. Smith, 10, Salisbury-st., Adelphi—Water level and pressure indicators and lubricators.

2471. J. Shaw, Britannia Iron Works, Neithrop, Banbury—Preparing the food of cattle.

2472. R. D. Atkinson, Kingston-upon-Hull—Preparing and coating metallic surfaces.

2473. E. O. W. Whitehouse, London, and J. C. Laws, Brighton—Tools for soldering metals.

2474. G. Thomson, Westbourne-grn., Harrow-rd.—Machinery for cutting or rending wood for laths.

2475. H. L. Pattinson, Scots House, near West Boldon, Durham—Treatment of certain salts and oxides of manganese.

2477. A. V. Newton, 66, Chancery-la.—Reefing, furling, and unfurling of sails.

2478. G. Webster and J. Webster, Fountain-yd., Bridge End South, Leeds—Opening and closing the slide valves of engines worked by steam or other power.

Dated 22nd October, 1856.

2479. C. H. J. W. M. Leibmann, Fartown, Huddersfield—Purifying water.

2480. G. Ermen, Manchester—Machinery for the finishing and treatment of yarns or threads.

2481. F. Walton, Haughton Dale Mills, near Denton, Lancashire—Brushes.

2482. G. C. Potts, New Oxford-st.—Cleaning of casks.

Dated 23rd October, 1856.

2483. C. W. Harrison, Woolwich—Insulation and protection of electric conductors.

2484. T. Gray, Ratcliff Works, Rose-la., Stepney—Drying apparatus.

2485. J. F. Porter, 11, Park-st., Westminster—Manufacture of bricks, &c.

2486. G. E. Johns, 4, Falcon-st., London—Optical or stereoscopic arrangement in the manufacture of boxes.

2487. J. C. Bremer, 166, Fenchurch-st.—Propellers.

2488. J. Macdonald, 13, Henry-st., Upper Kennington-la., Vauxhall—Regulating the supply of oil or other liquids, applicable to lamps, gas meters, &c.

2489. N. Brough, Birmingham—Dress fastenings.

2490. A. D. Bishop, Woolwich—Apparatus for facilitating the finding and raising of vessels and submerged articles.

2491. T. Horrex, South-sq., Gray's-inn—Fastening buttons.

2492. J. Walley, Derby—Preventing explosions in steam-boilers.

2493. J. D. Dunnicliff and W. Dexter, of Hyson-grn., Nottingham—Warp machinery.

2494. L. A. Desachy, Great Marlborough-st.—Improvements in producing architectural mouldings, ornamants, and other works of art formed with surfaces of plaster or cement.

2495. E. A. Athawes, 63, Blackfriars-road—Forks for forking land.

Dated 24th October, 1856.

2496. J. E. A. Gwynne, Essex-wharf, Essex-st., Strand—Carbon or charcoal powder for various useful purposes.

2497. I. Bailey, Bradford—Machinery for spinning wool, cotton, alpaca, mohair, &c.

2498. G. White, Bromley, Middlesex—Treatment of grain, in order to produce starch and spirit therefrom.

2499. R. A. Brooman, 166, Fleet-st.—Oil for burning in lamps, and an improved burner and chimney.

2500. W. Woodford, Taunton—Prevention or cure of smoky chimneys.

2501. R. Struthers, Holyhead—Machinery for transmitting motive power.

2502. W. Mills, Congreve-st., Birmingham—Improvements in apparatus for removing soot from chimneys.

2503. H. A. Holden, Bingley-hall Works, Birmingham—Furniture for railway and other carriages, and finishing or ornamenting the iron parts of harness.

2504. L. A. Mangin, 39, Rue de l'Echiquier, Paris—Self-acting door-spring.

2505. S. Baxter, Minories—Chain wheels, or barrels and stoppers to be used for raising and lowering weights by means of chains.

2506. C. Anciaume, 15, Quay Bourbon—Musical organs.

Dated 25th October, 1856.

2507. G. Ernst and W. Lorberg, Manchester—Producing designs, patterns, or impressions on the surfaces of plates, blocks, or rollers, and transferring or imparting the same to paper, parchment, woven fabrics, leather, or other similar materials.

2508. W. Benson, Four Stones, nr. Hexham, Northumberland—Drying grain, seeds, &c.

2509. C. J. Farrington and W. Comber, Hampstead—Apparatus for giving alarm in case of attempted burglaries.

2510. J. Sexton, Leicester-sq.—Caustic holders, applicable also to the holding of leads, chalks, &c.

2511. G. H. Bachoffner, Upper Montague-st.—Glass shades for gas and other artificial lights.

2513. H. F. Osman, 33, Essex-st., Strand—Contrivance for distending the skirts of ladies' dresses, and preserving the required form and shape.

2514. T. Brown, Fenchurch-st.—Capstans and windlasses.

Dated 27th October, 1856.

2515. B. Ferrey, Trinity-pl., Charing-cross—Producing ornamental plastering or stucco work.

2516. J. Birkin, West Bridgeford, Nottingham—Dressing and cleaning wheat

2517. H. F. Forbes, Florence, Tuscany—Copying press.

2519. T. Allen, Adelphi-ter.—Permanent way of railways.

2521. P. Schaffer and F. Schaffer, Brewer-st.—Handle for desks, boxes, bags, &c.

2522. W. E. Newton, 66, Chancery la.—Economising the waste heat of furnaces.

2523. M. Dognin, Lyons, France—Machinery for making lace or net.

Dated 28th October, 1856.

2524. W. Brodie, Belhaven, East Lothian—Roofing tiles.

2525. E. T. Simpson, Calder Soap Works, Wakefield—Soap.

2526. A. E. Ragon, Bernard st., Russell sq.—Indicating and recording the speed of ships.

2527. W. S. Losh, Wreay Syke, Cumberland—Preparation of size.

2528. J. L. Marie, Paris—Raising, propelling, and forcing water and other fluids, and obtaining motive power.

2529. W. A. Gilbee, 4, South-st, Finsbury—Smoke consuming furnaces.

2530. J. Armstrong, Normanton—Permanent way of railways.

2531. S. Russell, 12, Sheaf-gardens, Sheffield—Teapot handles, knobs, door-plates, finger-plates, razor scales, and knife handles.

2532. J. K. Cheetham, Rochdale, Lancashire—Manufacture of iron and steel

2533. A. Aubril, Newman-st., Oxford-st.—Application of a certain root to the manufacture of starch, paper, and cardboard.

Dated 29th October, 1856.

2534. R. Robinson, Eccles New-rd., Pendlebury, Lancashire—Machinery for sizing, dressing, finishing, and polishing yarns or threads.

2535. R. Hampson, Rochdale, Lancashire — Lubricating steam engines

2536. T. Garnett, Low Moor, Clitheroe, Lancashire—Manufacture of paste or size for sizing, stiffening, or otherwise preparing cotton and linen yarns and woven fabrics.

2537. T. E. Wyche, Camberwell—Disengaging metals from the matrix.

2538. L. A. Faure, Paris—Pump.

2539. T. C. Salt, Birmingham—Coating with glass or enamelling surfaces of cast iron.

2540. T. John, Pesth, Hungary—Electric telegraph apparatus for writing.

2541. T. S. Henzell, South Shields—Construction of ships or vessels.

2542. A. J. Thompson, Birmingham—Gum-pot and brush, and which said pot and brush are also applicable for holding and using liquid glue, paste, or other adhesive materials, as well as varnish, paint, and such like fluids, which are liable to dry up by the action of the air.

INVENTION WITH COMPLETE SPECIFICATION FILED.

2382. T. Gilbert, Massachusetts, U.S. — Pianoforte action or string-sounding mechanism.—10th October, 1856.

2807. J. H. G. Wells, 45, Essex-st., Strand—Windlasses.—15th October, 1856.

DESIGNS FOR ARTICLES OF UTILITY.

1856.

Oct. 17, 3891. T. Pemberton and Sons, Birmingham, "Door Spring."

,, 17, 3892. Smith and England, Wollaston Works, Stourbridge, "Improved Corn Shovel."

,, 22, 3893. T. L. Hemley, Calne, Wilts, "Chimney Top."

,, 23, 3894. A. J. Marriott, 237, Oxford-st., "The Ladle Pickle Fork."

,, 30, 3895. J. and E. Gleave, Stockport, "Improved Weft Fork."

,, 31, 3896. G. Wood and Son, Chelmsford, "Improved Turnip Cutter."

,, 31, 3897. Cope and Collinson, Birmingham and Oxford "Lever Table Catch."

Nov. 3, 3898. J. Walker, Doncaster, "Improved Water Closet."

,, 4, 3899. T. O. Jones and S. Jones, 33, Newgate-st., City, "Safety Pocket Protector."

,, 4, 3900. W. Russ, 27, Gloucester-st., Clerkenwell, "Bracelet and Necklet Fastenings"

,, 6, 3901. Key, Rudall, and Co., Charing-cross, "Portable Iron Military Music Stand."

,, 8, 3902. Taylor, Allen, and Taylor, Birmingham, "Back Pulley."

,, 8, 3903. J. Pedley, Charlton, nr. Manchester, "Boiler for Hot-water Apparatus."

,, 11, 3904. H. Craigie, Edinburgh, "Coffee Pot."

,, 13, 3905. L. Hicks, Leeds, and J. E. Smith, 6 and 7, New Kent-road, "A Travelling Rug or Wrapper."